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Instructions for Placing In Position and Connecting Underground Cables.

By Dr. G. H. Benjamin.

Superintendents of construction, as well as employes, attach generally too little importance to the laying of electrical conductors; they are, nevertheless, as necessary to the proper working of the entire installation as the electricity itself, which they serve to transport. Now that electricity is coming more and more into use everywhere, be it for purposes of lighting, transmission of power, heating, telephone, telegraph, etc., I believe it to be proper to state, briefly, the essential conditions which it is necessary to observe in laying a cable. With this information, an intelligent workman can install, without difficulty, a perfect underground electric conduit.

Trench.—The depth of the trench varies necessarily according to the nature of the ground. In cultivated earth a depth of one meter (39.37 inches) is necessary to place the cable in safety from any accident incidental to the cultivation of the ground; while along a road a depth of 50 to 60 centimeters (19½ to 23½ inches) would be sufficient. In a city this distance is more or less great, according as the cable is placed under or laid over obstacles, such as gas-pipes, water-mains, sewers, etc., which are encountered in the trench. It is unnecessary to state that it is always preferable to place the cable under the obstructions already existing when possible. In this manner the chance of breakage, which might take place in repairing and maintaining the pipes mentioned, is done away with.

Unwinding of the Cable.—The cable having been delivered wound on a drum of iron or wood, it is necessary, when the trench is ready, to put it in place. This operation is not always free from difficulties. I will describe the different methods of laying the cables, and review the principal difficulties which are liable to present themselves.

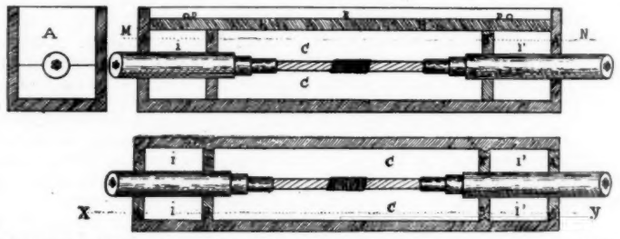
1st. When the trench is entirely free from obstacles throughout its entire length.

In this case, according to local circumstances, the number of workmen, etc., the unwinding is accomplished in different ways.

A. If the cable is short, or there are enough workmen, commence by placing the drum raised on an axle at one end of the ditch. All the workmen being assembled at the drum, one man takes the end of the cable, and, at a steady pace, advances in the trench, until he has run out 10 to 15 meters (33 to 50 feet); a second man now seizes the cable as it unwinds from the drum, places it upon his shoulder and takes up the march. When the second workman has gone a distance of 10 to 15 meters (33 to 50 feet), a third seizes the cable, places it upon his shoulder, goes forward with it, and so on, until the end of the cable is reached.

B. Instead of assembling all the men at the drum, commence by placing them at equal distances along the entire length of the ditch. The first man, placed at the drum, advances with the end of the cable to the position of the second man, in whose hands he places it. This one then advances to the third, while the first resumes his place, and continues to unwind the cable, at the same time holding it up with his hands. When the second man has reached the third, he remains in his place, while the third advances to the fourth, and so on. This manner is preferable to the firs', and can be used in all cases.

C. When the number of men is limited,



Figs. 1 and 2.—Methods of Connecting Underground Cables in Metallic Boxes.

or when local circumstances will permit, the following method can be employed:

The drum is placed upon its support on a truck. The first end of the cable is fastened in its proper place at the end of the trench, then the truck is moved forward the length of the trench; a few men will suffice to regulate the unwinding and placing of the cable in the trench.

2d. When the trench is not entirely clear, and the cable required to be placed under obstacles:

In this case, the two methods stated as *A* and *B* can be used. It will suffice, as fast as encountered, to pass the end of the cable under the pipes, sewers, etc., which obstruct the ditch.

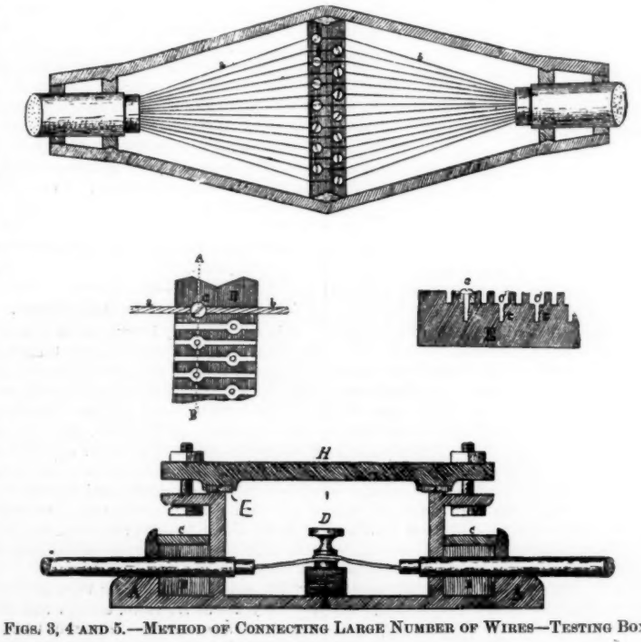
3d. When the entire length of the trench cannot be at first dug:

This case is that which usually presents itself in important plants. The following method should be followed: The drum is placed on its support at a point where the digging of the ditch has been discontinued. The men are distributed the length of the ditch, at nearly equal intervals. The first part of the cable is first put in position, as above directed, playing it out until its end has reached its proper position. When the following section of the trench is ready, the laying of the cable is continued by one of the following methods:

D. If the cable is not to pass any obstacles, the first workman re-takes the cable where it has been left, and continues the laying commenced, extending it forward in this manner.

That is, by doubling up, one person remaining in position at the bottom of the ditch while the other pushes forward. The first man being at a certain distance from the drum, a second takes the cable in his hands, then a third, and so on to the end.

E. The method last named cannot be used when there are obstacles under which the cable must be placed. In this case it is required to commence by first unwinding the cable from the drum out upon the ground, in order that the last end of the cable may be reached. This operation should be performed with great care. As the cable is unwound from the drum it may be coiled in a circle, but better still, in a figure eight (8). The cable should then be drawn along in the ditch under the obstacles there found. It may be the case that the end of the cable coincides with the end of the ditch already dug, in which case the operation is finished; but if the cable is longer than the ditch, the surplus should be wound upon a reel placed at the end of the trench, to be laid later. These manœuvres, when carefully executed, are not in the least dangerous to the cable, and allow the placing of it in localities where much traffic renders it inconvenient to provide an open ditch of considerable length. I will not speak of a plant in drains or sewers. This is ordinarily laid by special methods, and does not present particular difficulties.



Figs. 3, 4 and 5.—Method of Connecting Large Number of Wires—Testing Box.

Tarring of the Cable.—In earth, sandy or dry, the cable can be left without special protection, but in earth wet, and containing vegetable matter, the lead should be protected. The most economical process, and also the most efficacious, consists of coating the cable with a varnish of gas tar. This operation is performed with the greatest rapidity with the aid of a large brush, or, better still, by meads of a handful of hemp which one of the men plunges into the tar, passing it along the lead. (To clean the hands, use first kerosene, then soap.) This varnishing has a double utility, as while it constitutes the best known protection of lead, it serves also to completely keep away any corrosive material which might attack it. This operation finished, nothing remains to be done before filling in the ditch, except when many cables are laid together, to see that they are arranged methodically: that is to say, in such manner, that the same cables are placed in the same relative positions throughout the entire length of the trench. This precaution is necessary to facilitate the leading off of branch conductors, which may have to be done later, as well as to aid in searches for faults, which otherwise would be tedious and difficult.

Filling in of the Trench.—It is necessary to select with care, the materials which are to be in direct contact with the cable, for the thickness of a dozen centimeters (5 inches) nothing should be used but sand, vegetable earth, or other fine material. Sharp stones resting directly on the cable cannot fail to damage it, either at once or gradually during the filling in of the earth. In places where it can be foreseen that subsequent excavations will be made for the laying or repairing of water, gas or other pipes, etc., it is well to place a row of bricks over the cable, to render workmen careful in the work above referred to.

Joining.—It is rare that a single joint has to be made to join the end of the cable laid to end of one ready to lay. Where many drums are used, it is necessary, during the process of laying, to connect the different sections. This operation is always delicate, and cannot be done by other than experienced workmen. The following directions will, after a little inevitable awkardness, enable any intelligent workman to easily do the work.

Cable of One Conductor—First Method.—1st. Commence by removing the outer

casing of lead to a length of about 10 centimeters.

2d. Next cut off the inner casing of lead, allowing it to go beyond the first lead casing about 5 millimeters.

3d. Make a bandage or wrapping by means of a few turns of cord at a distance of 5 to 10 millimeters, from the end of the lead, and remove the first layer of insulating material from the end up to this point. Make then a second bandage a few millimeters further on than the first, remove the second layer of insulating material, and so on, until the proper conductor is reached.

4th. Slip on to one of the ends so prepared a tube of lead about forty centimeters in length, and of an interior diameter slightly greater than the outside diameter of the cable.

5th. Solder the copper conductors together.

6th. Take in the hand the different layers of insulating material previously removed, and wind on ribbons already prepared for this purpose. Wind evenly, back and forth, until a diameter is reached, nearly equal to that of the cable, the last layer being wound with a few turns of cotton cord.

7th. Plunge all that part thus prepared in a basin already filled with insulating matter heated to a temperature of about two hundred degrees Centigrade. This operation, intended to remove the dampness which the fingers may have deposited on the prepared ribbons, is finished when the bubbles of steam no longer appear.

8th. Cover with a mixture of melted pitch and boiled oil the parts of the cable to be re-covered with the tube of lead, which has been previously slipped over one of the ends of the cable. Fix the tube so that the joint will be in its center.

9th. Compress, at each end, the tube on to the covering of the cable with a special pinching tool.

10th. Solder, at each end, the tube to the covering of the cable.

11th. Cover over the two solderings with pitch; keep in place by means of a tarred ribbon.

12. This ribbon is fixed with a galvanized iron wire. This method is used exclusively where the joints have to be suspended, as is the case for example, in sewers, and the interior of buildings. When the joints are to be placed in a ditch, the following is a more rapid method, and that which gives excellent results.

N. B.—Under certain circumstances, it is impossible to make the soldering indicated under paragraph 10 above, in which case, it is well to replace the tarred ribbon, paragraph 11, with a band of flattened lead, much heavier and absolutely water tight.

Second Method.—1st. Commence by preparing the ends to be soldered.

2d. Solder the conductors, leaving the copper as short as possible. The simplest method of soldering is to splice the strands with each other, tightly wrapping the whole with a fine copper wire, then run on the solder, using rosin for cleaning; chloride of zinc must not be used under any circumstances.

3d. Thus prepared, the joint is placed in a metallic box, as indicated by the sketches herewith, marked Figs. 1 and 2. The box being open, place therein the cable, the joint occupying the middle space *C*; then the four slides *A B*, *A' B'*, intended to hold up the cable, are replaced. The central space *C C*, is then completely filled, nearly to a level with the pieces *B*, *B'*, with the insulating material heated to a high temperature; the spaces *I* and *I'* are likewise filled, but with melted pitch. While the pitch is still hot put on the cover *H*, and the two bolts or pins *D*, which should hold it. Then pour pitch upon the cover in such a manner as to fill the space *E*, and the joint is finished.

Cables of Many Conductors.—In this case, as in those mentioned, the principles of the preceding methods are followed.

Application of the First Method.—All the conductors of each of the ends having been prepared, and a tube of lead having been slipped on one of the ends, commence by rebuilding each strand, as indicated for cables of a single conductor, with the only difference, that the wrapping of prepared ribbon should not give to each conductor a much greater diameter than that which it occupied in the interior of the cable. This operation finished, the conductors are closely bound together by two layers of prepared ribbon, in order to obtain a diameter which must not, in any case, be greater than the outside diameter of the cable. The joint is then completed as in the case of a cable of a single conductor, having been first plunged into a basin of very hot insulating material.

Application of the Second Method.—For cables of two or three conductors, there can be used a box identical with that used with a single conductor. It will answer to keep the conductors sufficiently separated one from the other, to prevent danger of contact. When the cables have a greater number of conductors, 7,14 or 28, &c., the boxes will assume considerable dimensions if it is desired simply to place the wires at a distance from each other. The following method can preferably be used.

Cables of Seven Conductors.—The ends being prepared, and the wires separated, slip over the wires on each end until stopped by the insulation, ebonite disks pierced with seven holes having each the diameter of the copper strand, solder the conductors together, giving them all as equal a length as possible; place then the ebonite disks at equal distances, and finish the operation by placing the joint in a metallic box as stated. The same method could be utilized for joints destined to be suspended by replacing the metallic box with a tube of lead filled with insulating material and completed as has been explained, for cables of one conductor.

Third Method.—When the cables have a large number of conductors, it is quite difficult to join them all in the same length, and at the same time prevent danger of contact between them. To do this properly, proceed as follows for a telephone cable of fourteen conductors: The conductors of each end being conveniently prepared, the end of the cable is placed in a box, as indicated in the drawing herewith marked Figs. 3 and 4. In the center of the box, is placed a block of ebonite, *E*, representing fourteen transversed grooves into each of which is tapped a circular hole *o*. The ends of the cables being in place, commence by cutting the strand *A*, which is of two or more wires twisted sufficiently long as to pass over the ebonite bridge, place them in the first groove and separate the strands so as to allow for the passage of the screws. The same operation is performed for the strand of the conductor *B*, and the joining of the two wires is terminated by screwing down the screw *C* as much as possible, in order to obtain good contact between the two strands. When the first fourteen conductors are so connected, place a second piece of ebonite upon the first, binding thereon the fourteen other conductors. Nothing further is necessary than to fill the box with the insulating material as already described.

Testing Boxes.—When plants of underground conductors assume a certain development, it is necessary to divide them into different sections to be able at the proper time to discover defects which may arise in their working. There are used ordinarily to this end, metallic boxes, in the interior of which the conductors are placed bare and can be easily separated, one from the other. These boxes can possess a variety of shapes. Fig. 5 shows a box which has all the desirable qualities. *A* is a cast box, upon two opposite ends of which are formed chambers *B*. The cable of which the ends are prepared, is introduced through the two openings which are formed in the partitions of the chamber *B*, into the open space *D*. The spaces *B* are filled with melted pitch, then closed by the cover *C*, upon which is likewise poured pitch. The pitch which fills the chambers *B* has for object, the prevention of air or water being introduced into the space *D*. *E* is a washer or shield of rubber, arranged under the cover *H*, and which renders the joint tight by compression, through the instrumentality of four bolts. The different conductors can be connected in the interior of the box by means of ordinary connections; but it is preferable to use a block of ebonite with strong binding posts, so that the wire can be disconnected when tests are to be made. In every case where an important lead is taken off the main circuit, it is necessary to place one of these testing boxes at the point of connection, and also if used for the purpose of transmission of power or light, it should be furnished with an automatic cut off.

In joining a conductor to a cable, lay bare the copper strand of the main conduit to a length of about four or five centimeters, then twist several times the leading-off cable around the strand of the main conduit. Solder the connection, and place the whole in a connection box.

Running of Cables into Houses—Preservation of Ends.—The running of cables into houses is not always a simple and easy operation. I will speak only of cases where the cable is introduced on a level with the bottom of the trench. Commence by sealing into the wall, a pipe of iron or clay of the requisite diameter; pass through it the end of the cable, and fill the pipe with fine sand mixed with gas tar. The effect of the tar will be to keep out vermin, which, without this precaution, will not fail to use this as a means of ingress to the house. If the cables are to be carried to the upper stories, they should be placed beyond the reach of interference, and mechanical causes of injury, by placing them in a wooden moulding, the form of which will vary according to the character of the space which they are to traverse. In passing through walls, cement or mortar should not be used directly on the lead; nothing but plaster should be employed. It is not necessary to speak of the different precautions necessary to be taken in running wires in the different apartments. Every intelligent workman will know how to find a means of putting up a flexible cable for the successful placing of which it is only necessary to preserve intact the lead covering. If the insulating material is without other protection at the ends of the cable, it may happen at the end of a certain time, that the cleaning necessary to remove dust, etc., will cause a separation of the different layers of the material used. It would then be liable to cause a short circuit between the different conductors, or between the conductors and the sheet of lead. To prevent such accidents, the ends of the cable of one or more conductors should be encased in a sleeve of ebonite pierced at one end with a number of holes equal to that of the conductors, and which fits exactly on to the outside lead casing. Dust can then be readily removed without fear of causing disturbance. As an extra precaution to prevent the introduction of dampness into the ebonite sleeve, it should be filled with melted paraffine at the moment it is put in place.

The Electric Light for Lighthouses.

It is not generally known in this country that long before the electric light became a commercial article, its value for lighthouse purposes was appreciated by the French, and in the year 1863 it was applied to the first-order lighthouse of La Heve, near Havre. The experiment was made with an Alliance Magneto-Electric machine and a Serrin lamp; the results were considered satisfactory, and a year and a half later the other lighthouse of La Heve was lighted in the same way.

In 1870 the following report was made to the French lighthouse establishment:

"The electric light having been installed for six years at La Heve, enough time has elapsed to allow us to form an exact idea of the value of this means of producing light for the lighting of coasts. Sailors take pleasure in recognizing the good services rendered them by the electric light. The advantages of the system have been highly appreciated; the increase of the range of the light is very apparent; and, above all, in slightly foggy weather, many ships can continue their voyage, and enter the port at night, which they could not do when oil was used. The light, which at first was rather unsteady, gradually acquired a remarkable fixity, thanks to the improvement of the apparatus and to the experience gained by the keepers. The fears which were at first entertained regarding the delicacy of certain parts of the apparatus are not realized in practice. The accidents have been rare, the extinctions short and very few, two only during this period of six years having had a notable duration; one, of an hour, was due to an accident to the steam engine; the other, of four hours, should, it appears, be attributed to malevolence. Under these circumstances, it seems hardly worth while to worry about possible accidents."

Since then the electric light has been used at several other lighthouses in France; at Cape Lizard, England; Odessa, Russia; Port Said, Egypt, and at a few other places.

Its adoption would doubtless have been more general had it not been for the great expense attending its installation and the doubt held by many lighthouse engineers as to the fog-penetrating power of the electric light.

The more general use of the electric light commercially incited inventors to produce new and improved methods of burning existing illuminants, and burners for oil and gas were made which were far superior to any that preceded them. These could be and were cheaply applied to existing lighthouses, and became powerful rivals to the electric light.

The following table shows the candle-power which has been obtained from various styles of gas and mineral oil burners:

Burners.	Candle-Power of Naked Light.
Douglass, 10-ring, gas	2,500
Douglass, 6-ring, gas	825
Wigham, 108-jet, gas	2,300
Wigham, 88-jet, gas	1,400
Wigham, 68-jet, gas	990
Wigham, 48-jet, gas	680
Wigham, 28 jet, gas	250
Sugg, 6-ring, gas	820
Siemens, gas	600
Douglass, 7-wick, oil	950
Douglass, 6-wick, oil	730
English service, 4-wick, oil	415
American service, 5-wick, oil	424

The Trinity Board, in England, has lately made exhaustive experiments to determine the relative merits of oil, gas and electricity as lighthouse illuminants. The report of the committee charged with these experiments was made on the 7th of last August. I quote their summing up, from advance sheets of their report:

1. That the electric light, as exhibited in the A experimental tower at South Foreland, has proved to be the most powerful light under all conditions of weather, and to have the greatest penetrative power in fog.

2. That for all practical purposes the gas-light, as exemplified by Mr. Wigham's multiform system in B experimental tower, and the oil-light, as exemplified by the Trinity House Douglass 6-wick burners in multiform arrangement up to triform in C experimental tower, when shown through revolving lenses, are equal, light for light, in all condi ions of weather, but that quadriform gas is a little better than triform oil.

3. That when shown through fixed lenses, as arranged in the experimental towers, the superiority of the superposed gas-light is unquestionable. The larger diameter of the gas flames, and the lights being much nearer to each other in the gas lantern, give the beam a more compact and intense appearance than that issuing from the more widely separated oil burners.

4. That for lighthouse illumination with gas the Douglas patent gas-burners are much more efficient and economical than the Wigham gas-burners.

5. That for the ordinary necessities of lighthouse illumination mineral oil is the most suitable and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light is required electricity offers the greatest advantages.

In 1883 I wrote as follows in an article entitled "History of the Application of the Electric Light to Lighting the Coasts of France," published in *Science:*

"The arc light has two defects—one a lack of fixity, the other a deficiency in the red and yellow rays of the spectrum. * * *

"The red and yellow rays have the greatest penetrating power; and for this reason an

oil-light, which is rich in these rays, can be seen farther in foggy weather than an electric light of equal candle-power. But the electric light can be made so much more powerful than the best oil-light that this deficiency can be more than made up; still, it must be borne in mind when the candle-powers of the two lights are compared."

The same defect is referred to more fully, and the same conclusion reached, in the report of the committee appointed by the Trinity Board, as follows:

"The object of the photometric experiments was to discover the approximate ratio in which each light was cut down in thick weather. If two lights suffer an equal loss—of one-half their illuminating power, for instance—by passing through half a mile or a mile of haze, then it may be assumed that the loss will continue in the same ratio, and their penetrative power at a distance will correspond with their initial illuminating powers. But if two lights suffer a very unequal loss by atmospheric absorption, then their initial illuminating powers are no longer any index of their penetrative powers. * * * The measurements made indicate a relatively high coefficient of absorption for the electric light, for a haze which cuts down the gas-light by one-third of its power, and a lower, though still high, co-efficient of absorption for a haze which cuts down the gas-light by more than one-half its power. No doubt, the electric light suffers a selective absorption, the more refrangible rays being first removed; and the loss suffered in the passage of the light through successive layers of the atmosphere becomes smaller as the more absorbable constituents of its rays are filtered out of the beam. This selective absorption is apparent to the eye. Seen through a haze at a distance, the electric light loses its blue tint, and loses also much of its unsteadiness. The question is, Are the residual rays of the filtered electric beam stronger than the residual rays of the gas-light when the latter are reduced to the disappearing point? No doubt remains that, with the great initial intensity available at the South Foreland, the electric light carries farther through haze than the strongest beam obtained from the gas and oil towers."

In my opinion, the arc light has the following great advantages over any other artificial light:

Its power is many times greater. The lens required for its use is much smaller than that for other lights, owing to the small size of the luminous source.

It has, however, the following defects: Its installation is very costly, and it requires a mechanic of first-class ability to attend to it, and to the necessary dynamo and engine.

Even with the best lamps (regulators), the arc does not remain exactly in the optical focus of the lens, this is due to one of the carbons burning faster than the other. This, of course, can be compensated for by proper mechanism in the lamp when a continuous current is used, or by using an alternating current. Even then, however, if both carbons are not homogeneous, one will burn faster than the other, and the arc will have to be brought back by hand to its proper position. This requires constant attention.

Its greatest deficiency is in its lack of the red and yellow rays which are the most penetrating in foggy weather; therefore, in clear weather it is much brighter than necessary, and in foggy or hazy weather, when the light is needed, it is but little more powerful than light from cheaper sources.

There is another form of electric light, however, possessing certain advantages which make it peculiarly valuable for lighthouse purposes.

In 1883 I wrote: "When the French system was adopted, the incandescent electric light had not left the domain of experiment, and even now its luminous intensity is very much less than that which can readily be obtained from an arc light of moderate dimensions. It possesses, however, the element of remarkable fixity, and is rich in red and yellow rays. No light could be better for a lighthouse, if it can be produced cheaply, have sufficient luminous intensity, and be made reliable. It will, moreover, dispense with the somewhat complicated and expensive regulators."

Since then I have had no reason to change my views; the incandescent lamp has already been so improved as to considerably increase its power, and I see no reason why its power should not be made still greater, so as to vie with oil and gas-lights. It, moreover, has the great advantage that it can be readily adapted to existing lenses, while the arc light requires a special form of lens and lantern, thus entailing large expense in making any change.

I do not expect that the cost of producing light of low power by means of the incandescent system can be reduced to the cost of oil lights, but I think it by no means impossible to make an incandescent lamp of, say, 1,000 candle-power, which could be maintained without undue expense, and which, owing to its richness in yellow rays, would be equal in fog-penetrating power to an arc light of about 10,000 candles.

Another and important advantage of the incandescent light is, that it generates but a small quantity of heat, and thus is easily adapted to lights of the "triform" system—*i. e.*, three lights and lenses superposed on each other. This, it is true, has been accomplished with both the gas and oil-lights, but it could be much more easily and cheaply done with incandescent lamps. With this system one light could be used in clear weather, two when it was hazy and three in thick fog, and it would be under the perfect and instant control of the keeper.

In short, if cost is not considered, there is but one difficulty to be overcome in order to make the incandescent electric light the ideal light for lighthouses, and that is its lack of power. Hitherto but few attempts have been made to greatly increase this; small lights for domestic purposes, in the place of gas, occupying the attention of inventors, as, for the purpose of illuminating large spaces, the arc light is much the cheaper of the two.

DAVID PORTER HEAP.

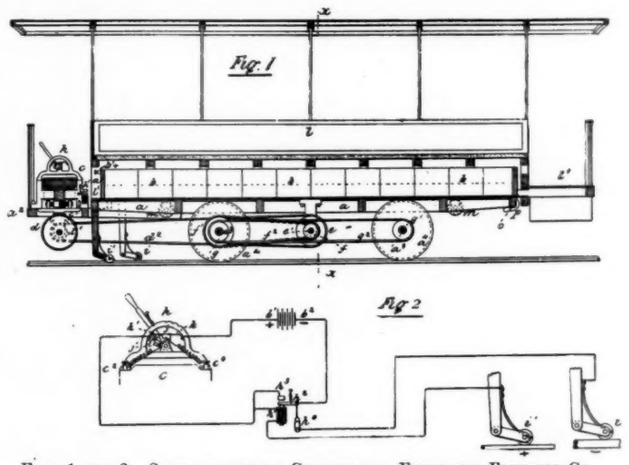
"Electric Locomotion."—Self-Propelling Cars.

The above heading is the subject of a patent issued to Mr. John M. Pendleton, assignor to the Equitable Electric Company of New York, dated July 28th, 1885. The patentee, we are informed, was in 1882 the first manufacturer of the Faure Storage Battery in America, and also that he has had in use a battery of electric accumulators from that period to the present time.

The system for self-propelling cars in utilizing stored energy, as described hereinafter, is the result of experiments to use most advantageously accumulators for traction purposes, and it is claimed to meet these purposes for extended systems and in securing some important advantages not attained by any other system of electric locomotion yet brought before the public.

The practicability of electric locomotion is now attracting the closest attention of scientists in the United States, as well as those of England, France and Germany. To be able to substitute a method of moving vehicles (where steam cannot be applied) and replace the use of horses by electricity on tramways is an object greatly to be desired, especially for the economy that is apparent by this substitution, irrespective of the consideration that sustains societies for the prevention of cruelty to animals. The evidence lately brought forward by our most eminent scientists (among them Professor Doremus) has caused a certain interest in a sanitary point of view, to the effect that some injury is inflicted by the present system of horse cars in metropolitan districts upon the noble animal man, by his useful and inferior ally by reason of the filling of the atmosphere of all large cities with a fine dust, a great part of which is composed of the manure of the latter. Any system that will substitute successfully a self-propelling car, and replace the use of horses with the ability to distribute passengers as conveniently at any point, should, as a matter of certainty, be preferred.

In all electric systems now proposed, the transportation is limited and confined to the route covered by the electric conductors on the railway, allowing neither a deviation nor extension of the route, nor providing for the use of power separated from that afforded through the energy furnished direct to the motor from the conductors.



FIGS. 1 AND 2.—SELF PROPELLING CARS OF THE EQUITABLE ELECTRIC CO.

This system proposes an electrically self-propelling car in lieu of horse cars, capable of distributing its passengers over branch lines to the trunk electric line, supplementing that supply by means of accumulators or stored electric energy, contained in and operating the locomotive car on the branch line.

These self-propelling cars are adapted to be used on all lines provided with the means of supplying the electric current to the cars while in motion.

The electric motor truck comprises the wheels, axles and suitable frame work, containing a battery of accumulators or storage cells, and the electric motor, constituting the running gear of a detachable car body, and when connected and carrying the latter, forming the self-propelling car for passenger traffic. At a terminus or any station on the road the motor truck may be removed from under the car body and replaced by another whose stored supply of electric energy has been renewed, the car body remaining supported by its own frame-work during the change. The electric locomotive is detached as hereafter described, and is replaced by another one substituted, ascending the track so soon as the frame is switched out of the way, which carries the car body upon the journey recommenced. One end only of the motor car or truck is provided with a platform on which is secured the electric motor arranged with its armature shaft, operating the counter shafts and chain belt connecting the axles, the driving pulleys and driven pulleys being proportioned to reduce the number of revolutions from the high speed required for electric motors as compared with the speed desired to be imparted to the axles.

Attached to the motor truck is a box formed by two longitudinal timbers or girders which contain the accumulators in circuit with the electric motor through a switch as shown on the diagram. The electric motor preferred is of the class wherein the armature and field magnets are joined in multiple arc, the current in the permanent electro-magnets being changed by a commutator which governs the direction of the motor.

The electricity is supplied by contact rollers or brushes to the motor or accumulators, or both of them. Between these contact rollers is placed an automatic current switch, whose function is to control the supply of electricity to the motor, and, whether drawing the energy from the conductors, or from the storage cells, it secures the requisite supply at all times from one or the other source as the circumstances require; thus sidings and all the changes of line are provided for.

The great advantage of this electric system and of the construction which is illustrated in this edition, is to enable electric cars to operate on lines of greater length than can be served in any other way from a single station.

It will be readily appreciated that by this arrangement, when the motor is receiving electricity and propelling the car, the electric current is also charging the storage batteries while the car is in full motion and passing over any portion of the line provided with conductors, so that when a branch or continuation of track is met unprovided with conductors, the stored energy is available and used as a motive power to propel the car until it may have returned to such portion of the track provided with the conductors as mentioned.

The experiments made in Europe of actuating cars by electricity, relying solely upon accumulators and electric motors, proved that it was possible to give a service of over thirty miles by that method, and competing economically with the usual omnibus and car-team business. The description given by Mr. Reckenzaun, of the accumulator made by the Electrical Power Storage Company, of London, used for electric locomotive, is as follows:

"The battery of 60 cells weighs 1¼ ton, and contains energy sufficient to propel a car with electric motor and 60 passengers, the estimated gross weight being about 4½ tons, over a road with ordinary inclines and curves, at a rate six miles per hour for two hours, which is equal to the distance of 12 miles, and making stoppages 60 times each hour if required during the journey.

"The battery of 60 cells will afford 120 volts E. M. Force. The capacity of the cells is given at 150 ampere hours. Whereon, it appears, that allowing the ample deduction of 30 ampere hours for residual change, the available energy of the battery is nearly 20 horse-power for two hours, or 10 horse-power per hour, of which the electric motor would on the average return an available energy of six to seven horse power, working up to 10 and 15 horse-power for short periods upon emergencies to overcome grade or similar needs."

In a table illustrating the amount of power exerted by two horses upon a car containing passengers, the total weight of which was 4½ tons, it is stated:

At 7 miles per hour, on level road, requires							2.52 h.p.
" 6	"	"	"	"	"	"	2.16 "
" 6	"	"	"	"gradient 1 in	75	"	4.32 "
" 5	"	"	"	"	1	57 "	5.04 "
" 4	"	"	"	"	1	" 37 "	4.32 "
" 3	"	"	"	"	1	" 25 "	4.32 "
" 4	"	"	"	"	1	" 25 "	5.76 "
" 5	"	"	"	"	1	" 25 "	7.02 "
" 3	"	"	"	"	1	" 18 "	5.04 "

While propelling the car around curves the power absorbed is greater and variable according to circumstance, and at same time the starting force is about four times the tractile force required when under way.

These figures afford valuable data by defining the mechanical power exerted.

In the United States, the Viaduct Manufacturing Co., of Baltimore, Md., are manufacturing good commercial storage cells at reasonable figures, capable of the work required of them, made in different sizes containing energy to operate self-propelling cars for periods of two or six hours, and claimed to be fully equal to the English accumulators. An experimental use of their storage batteries in connection with the Daft system of electric railway in Baltimore, resulted satisfactorily, and was described in the columns of this paper during July last, and further developments are shortly expected.

Electrical Review.

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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The *Kansas City Review*, edited by Theo. S. Case and Warren Maton, comes out in improved form. This is a more valuable publication than the West is generally supposed to produce, and its pages give evidence of intelligent and careful editing. It should be well sustained.

Dr. G. H. Benjamin's article on the work of burying cables, which we illustrate in this edition, is of special interest at this time to all who are engaged in laying cables. Dr. Benjamin has had extensive experience in Paris in this line of work, and at the recent electric-light convention was one of the prominent speakers.

In Milwaukee a remonstrance against the stringing of electric-light wires on poles has been presented to the city council. The petitioners do not state where they would have the wires placed, and it is to be presumed they don't want the electric light at all. It is as dangerous to place arc light wires under ground as over head, in fact, many insurance companies prefer the overhead, visible wire to that of the concealed wire beneath the surface of the earth, which enters the building at a point that is seldom visited, and consequently more liable to get out of repair.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. Frank Ridlon, of the Executive Committee of the National Electric Light Association, is actively engaged in the work of preparation for the next convention, and is now making arrangements for securing the best and most uniform system of testing carbons. He is chairman of the committee on carbons appointed at the recent convention, and is desirous of bringing about an understanding between the various carbon manufacturers and the users, by which all carbons are to be submitted to an agreed test before being sent out. What this test shall be is the point on which Mr. Ridlon desires the opinion of all who are interested. His address is 209 Washington street, Boston, Mass., and we trust our readers, to whom this matter is important, will at once communicate with him. We are informed that other committeemen are promptly taking hold of their respective subjects, and we will soon be able to give our readers additional information in regard to the progress being made. All letters received from an officer of the association should be promptly answered.

CHARGING AT A WINDMILL.

Our hot-headed friend and canny neighbor, the *Times*, almost had a fit last week after reading Dr. Green's testimony before the Commission on Electrical Subways. In a very pretty frenzy it said:

"Precisely what advantage the Commission on Electrical Subways gained by listening to Dr. Norvin Green, President of the Western Union Telegraph Company, yesterday, it is difficult to see. Dr. Green presented no plan for the consideration of the board, and no suggestions except such as were designed to discourage it in the work which it was created to perform. He described the iron tube system partially in use by the Western Union, but this is evidently not adapted to the general use of all the companies, which is one of the main requisites of any plan which the commission may ultimately adopt. For the rest, Dr. Green devoted himself to showing, according to his own standard, that the German telegraph service, which in the large cities is under ground, is not as good as that of the Western Union; that the London service, which is confessedly better, does not require so much wire actually under ground as the New York service under the present law; that buried wires are more costly that wires strung on poles, which everybody knows, and that if the wires are placed under ground here the same thing will have to be done in other cities, which will result in retardation disastrous to the service."

Curiously enough the very reasons which impelled the *Times* to doubt the expediency of giving a hearing to Dr. Green, strengthens us in the ground we have taken and given expression to from the first, that the commission would do well to hear both sides fully. It is illogical and un-American to form an opinion on *ex-parte* evidence, and such evidence is usually of little value.

The *Times* has a bad way, if it will excuse us for being so frank, of entering up judgment and pronouncing sentence before hearing the evidence. It has made up its mind that the wires must go under ground, and the project seems to it feasible because it has heard that in some other places the wires are buried. But has it ever inquired as to the cost and efficiency of these buried wires? Is the *Times* prepared to pay double and perhaps quadruple for its specials, and to have them frequently delayed beyond the hour at which it goes to press? If not, let it have

> "A continent forbearance
> Till the speed of its rage
> Goes slower."

Perhaps the reason that Dr. Green "presented no plan" to the commission was that he had'nt any to present. But he told what he knew about underground wires, and we know of no man so competent to speak upon the practical side of this question as Dr. Norvin Green. It matters not whether we admire the Western Union Telegraph Company and its methods, or whether we do not. The question for the commission is: May the wires be buried or not? We put the matter thus interrogatively because the Legislature inferentially expressed a doubt as to the feasibility of the project when it accepted the amendment to the original bill, clothing the commission with certain powers of discretion.

Were the commissioners to confine themselves to listening to men with underground tubes and systems they would like to sell, they would soon come to the conclusion that the cheapest, most expeditious and effective means of carrying on any kind of electrical service was by the underground method. What they want information upon are the objections to burying the wires; and how can they obtain that unless they give an attentive ear to the objectors?

The *Times*, like all unreasonable people, is inclined to misstate the facts. It says that Dr. Green came before the commission to prove that the wires cannot be buried. On the contrary, he came before the commission to tell all he knew, either for or against underground wires.

This is no special plea against underground wires—it is only horse-sense, and a very good thing to keep on hand, even in the office of a daily newspaper. Dr. Green admitted, as will be seen, that it was possible to bury the *telegraph* wires, but that it was expensive, even on main lines, and not to be thought of on branch lines.

In other words, the cheap and convenient telegraph we have now through all the streets of the metropolis, and which there was reason to believe would be still cheaper in the future, would have to be abandoned. Only a few wealthy people could afford to pay the rates necessitated, and it would not pay the companies to serve them.

As to the absurd project of bunching the telegraph, telephone and electric-light wires and burying them together, Dr. Green showed the impracticability of such a plan, and the truth of his assertion any electrician, who has mastered the first principles of his profession, will attest.

This is the whole thing in a nutshell. Any one who has been abroad and used the telegraph there knows that, so far as efficiency, it is not to be compared with ours, save, perhaps, in London we mean what is known as the "city" proper. And there, as Dr. Green says, they have underground railways running in every direction, and can place the wires in these tunnels or subways.

In Europe, where the general public is considered last, they have to put up with any kind of service the State is pleased to supply them with. The lines being underground, the service is sometimes very slow by reason of "retardation"—common to all underground lines. But here, the people being Sovereign, they grant the franchises to the companies, and are apt to howl with rage at anything in the way of delay, or miscarriage. They want not only good and prompt service, but also cheap service. Only a native American can imagine the intensity of the indignation that would go up from all sides were the rates for special service raised so as to be within the reach only of the rich. Yet neither the Subway Commission nor the State itself could force the electrical companies to do business at a loss.

Indeed it is a very doubtful question if the companies could, constitutionally, be forced to bury their wires, unless the State pays every dollar that is necessary in the construction of subways, besides the cost of taking down the aerial wires and placing them therein.

The *Times* should not, like Don Quixote, charge so fiercely at what seems an enemy in front, for the enemy may turn out to be only an inoffensive wind-mill, and in the crusade it has set out upon, it should remember that "he should boast who taketh his armor off rather than he who putteth it on."

THE NEW TELEPHONE SUIT.

The following from the New York *Times*, will be of particular interest to our readers in the telephone field, especially that which relates to the influence Mr. Bell is reported to have brought to bear on the Patent Department officials to secure the favor granted his application:

"It is the United States that now seeks to show by a suit in the Federal courts that Alexander Graham Bell was not the original inventor of the telephone, and that for this and other reasons the Bell patents, under which the telephone business is carried on, should be canceled. Mr. Bell and the American Bell Telephone Company have been opposed heretofore in all suits relating to this subject by corporations or rival inventors who had entered the field in competition. It is an opposing company, in response to whose application the Government now proceeds, but it is the Government that sues "in behalf of itself and of all the people and inhabitants of the United States and Territories," because the evidence offered by the applicant is regarded by the Department of Justice as a sufficient basis for such a suit. This fact will probably make the trial more interesting and important than any in which the Bell Company has heretofore been a party.

"The petition or application was addressed to the Hon. Henry W. McCorey, United States Attorney for the Western District of Tennessee, on the 29th ult., by W. Van Benthuysen, President of the National Improved Telephone Company; Charles P. Huntington, of Mississippi; J. R. Beckwith, of New Orleans, and George Gantt, of Memphis. With the evidence attached it was laid before Attorney-General Garland, who permitted Mr. McCorey to begin and carry on the suit. His bill of complaint has been filed—the defendants being the Bell Company and Mr. Bell—and the case will be tried in the United States Circuit Court at Memphis.

"While one of the grounds of complaint is that Mr. Bell was not the original inventor, and that he knew he was not, the suit is also based upon a new body of evidence relating to the manner in which the Bell patents were procured. The statements of the complainant with reference to the prior discoveries of Reis and Mr. Bell's knowledge concerning the same have appeared in part, at least, and have been used to some extent in other suits. The new evidence is important and especially deserves attention.

"The bill asserts that Mr. Bell was enabled to secure his first patent by means of information unlawfully communicated to him or to his attorneys by an officer of the Patent Office. This information related to the contents of a caveat filed by Elisha Gray, of Chicago. Bell's application for a patent was filed on Feb. 14, 1876, and on the same day Gray's caveat was filed. The application was assigned to Z. F. Wilber, an examiner in the office. The law requires that a caveat shall be placed in the 'confidential archives' and shall be 'preserved in secrecy.' But Wilber informed Bell or his attorneys that Gray's caveat had been filed, and that three claims in Bell's application related to matters specified in the caveat. He also informed him that on this account the application had been suspended for ninety days. Thereupon Bell, it is alleged, convinced Wilber that although the application and caveat had been filed on the same day the application antedated the caveat an hour or two. For this reason the suspension was revoked. Then Bell, it is said, amended his application in a manner suggested by the information concerning Gray's caveat, which he had obtained from Wilber. The amendments were allowed, and a few weeks afterward the first Bell patent was issued. The court is asked to repeal, recall, or cancel the patent because it was procured wrongfully and contrary to law. Among the exhibits submitted by Mr. Van Benthuysen and his associates is the affidavit of Wilber, the examiner.

"The evidence concerning the inventions of Reis and others will undoubtedly be fully presented, but the most sensational evidence, and perhaps that which will be the most effective, will be the facts, whatever they may have been, about the advantages said to have been gained by Bell through the action of the examiner and his superior officers."

GENERAL WESTERN NEWS.

Two cyclones played havoc on the night of the 8th instant. This time the elements selected Ohio for a stamping ground, where, as the southern Ohioans express it, cyclones have "used" before. The counties of Montgomery, Clarke, Greene and Fayette, in that State, bear traces of former storms of this character, and these were in the track of the present destroyer. Bloomsburg was almost completely destroyed, and at least three lives were lost. Washington Court-House, a city of 4,000 inhabitants, 25 miles west of Springfield, was nearly obliterated. The storm came from the southwesterly direction from near Seymour, Ind., and selected the principal business street of the town for its route. Railroad depots were wiped out, and three churches shared the same fate. Five dead bodies were found immediately after the storm had passed, and the telegraph having been rendered entirely useless, an operator was compelled to open a temporary office two miles out of town by tapping the wire, where he sat in a drenching rain while he communicated the information to the outer world. At this point the wind-storm lasted ten minutes.

Three hours previous a similar storm, following a nearly easterly direction, struck near Adrian, Michigan, passing about two miles from the city into northern Ohio.

Circleville, O., says the storm passed through that county a few miles south of that place, unroofing houses and prostrating trees and fences, and was succeeded by a heavy fall of rain. Napoleon, O., was also near its track, the town proper suffering but little damage, being two miles off the center line of the storm. Crops were seriously damaged in the rural districts, and buildings were demolished, the storm passing northeasterly at that point. It crossed the southern division of the Lake Shore road near Elmore, and the northern division near Oak Harbor, leveling the telegraph lines, the corn and doing other damage in a wholesale manner. At Colesville, Miame county, it made its mark, about a mile in width, by a length of forty rods. Cambridge City, Seymour and Dublin, Ind., were also sufferers. Other towns in its route, which report losses of property, are Osceola, Pike and the more sparsely-settled districts in Crawford Co., Ind.; Champaign, Summit and Portage counties, Ohio.

Its track through Michigan lay mostly outside of the thickly-settled districts. A gentleman near Rome, in that State, says he saw the birth of the whirling devastator. At that time it was, to use his own language, "no larger than a pot boiling, but it soon gathered strength, and not many seconds elapsed before it had started on its career of destruction." The jumbled geography of the above statements, as they were hustled in by telegraph, shows two simultaneous storms.

The loss of life, considering the fury of the storms, is inconsiderable, owing to the selection of route, which for the most part lay outside the densely-populated portions of the districts visited. The loss in property is large — at Washington Court-House alone $1,000,000, as estimated.

There are many curious incidents related, which in former times would be cited as of the special judgment order. A dry-goods merchant in the town last mentioned had a stock of $100,000 value, not a trace of which remains. Another building, in which were the telephone exchange and a dry-goods store, had the upper portion demolished, while the lower part was left standing in a dilapidated condition. The manager of the exchange, Herbert Haggert, jumped from the window to the ground, where he was injured by the falling roof, and subsequently died. Odd Fellows' Hall was occupied at the time by forty brothers of the mystic fraternity. The tornado completely wrecked the building, leaving nine of the brothers clinging to the walls of the adjoining block, and were taken down by ladders. Yet not one of the brotherhood received any physical injury. Between a two-story dry-goods house on the one side and several buildings on the other, all of which were razed to the ground, Music Hall, where the Salvation Army holds its meetings, was scarcely injured, while the Coliseum Skating Rink building was completely demolished, and every skate whirled away—a timely warning to roller skaters.

A gentleman with his wife and child, at Oak Lawn, were carried about one hundred feet on the floor of their sitting-room, and set down without injury, while the house was totally wrecked; and still another family, consisting of Mr. Monse, wife and three children, went with the floor up through the house. They landed safely, but neither floor nor any trace of the house, save the cellar, has been seen since. The number of exceptional escapes from instant death is hardly short of miraculous.

In all the above there is abundant testimony to disprove the venerable theory, until latterly deemed correct, that all this class of whirlwind storms, both on sea and land, are endowed with an enormous sucking power and upward atmospheric pressure, which draws to the interior of the funnel, and subsequently drops to the surface large portions of the debris it causes. Facts are much at variance with the generally-accepted theory. So called water spouts at sea are popularly supposed to draw up the water, which afterwards descends in immense rainfalls or sudden avalanches. Eye-witnesses who have carefully noted the action of these frightful meteors at short range are very positive in their testimony that, so far from the surface rising to the passing funnel, there is a very perceptible and positive depression of the surface at that point—in short, that the action in air is precisely similar to that of water in a whirlpool. The water which falls when a cloud-burst deluges the earth at the dispersion of one of these phenomena is accounted for by the large amount of moisture which is contained within the funnel, precipitated by condensation when the moist, warm atmosphere is brought in contact with the surrounding cooler medium. The rising and falling of the cloud is not unlike the water movement known as "boilers," which may be seen in any large, swift body of water where whirlpools are frequent, and in all the phenomena of these so-called cyclones their exact counterpart is seen in the movements of fluids, only modified by the difference in the specific gravity of the two fluids.

At the corner of VanBuren and Franklin, from the rear window of one of the upper windows of the Van Depoele Company's establishment, two mysterious wires run to a sort of derrick on Franklin street, where they are attached to a couple of aerial cables about 500 feet long, terminating on Market street. Midway between the terminals a third frame is erected, so that the length of the cables is formed of two catenary curves of about 500 feet. Upon these is suspended a small car which contains a motor, and by means of its wheels forms contact with the generator used for running the machinery of the company. Two stops on the cable serve as pole changers for the little car, and the astonishment of the audience which gathers when it moves, is complete and striking. There is a mystery about it which makes the ignorant bate their breath, as they endeavor fruitlessly to discover the motive power. To see it climb and pass down the incline at the center of the line, stop and reverse at the end of the route, and do all this without any apparent cause, is a series of effects which in the blue puritanic days of Salem would have cost the inventor his life. Yet the whole to-day is simple enough to all the better-read citizens of the world.

A still more extensive line of road in commercial use also runs by the Van Depoele motor is to-day in Toronto, Canada, carrying at each trip an average of 200 passengers from the street-car track terminal into the fair grounds, a distance of about one mile. A different arrangement was necessary in this case, and the car running upon rails which form one connection, are connected to a suspended wire overhead by a grooved pulley, in a very simple, but ingenious manner. The pulley, which is rigid, on passing a suspension point, raises the wire and its support as well, the latter being flexible, so that no loose connection can interfere with a constant supply of current.

The little motor is doing a land office business, carrying passengers, and tests of speed show that the Van Depoele system is capable of a very high realization in that direction. The inventor has been in personal charge of the engine and its work for some days, and has personally run the train, endeavoring to find some flaw in the system. He returned to Chicago, well satisfied with the results. The present line of track includes that used by the original system last year, but the road has been materially extended for the present exhibit, and some slight improvements in the motor's make-up have rendered the system thoroughly perfect and practicable for railway purposes.

Somebody once said that, "If a pin, bent in the shape of the letter U, be held on a tooth-pick, or other insulator, between the two poles of a static machine, the discharge to the pin would be dissipated in the air without reaching the opposite pole of the machine." The assertion was positive enough to almost carry conviction in its train, and the necessity of attempting to prove its falsity seemed needless. But it was tried nevertheless, a few days since, and the result was astonishing, truly. To be short and definite, the pin only served like any other conductor placed between the poles, to facilitate the discharge from one to the other. The dissipation, plainly seen in the dark, was toward the opposite pole, and when the distance was sufficient to provoke a spark discharge, this went as readily as from any other stepping-stone in an electrical path to the other pole. The moral is obvious, and suggests to one that the only way to contradict some people is to try for the results they claim to have found, and when these are proved fallacious, why—let it go for what it is worth.

When the king asked his courtiers why a pail of water weighed no more when a live fish was placed therein, the philosophers were in a quandary, until one of the simpler minded tried the experiment, and answered "Because it doesn't."

A peculiar leak in an electric-light circuit was developed a few days since, which is, perhaps, worthy of being noted and remembered. A circuit which, including the dynamo, was in excellent condition, its insulation measuring higher than required by law. But the next day the insulation had dropped to an almost dead ground. The floor had, in the mean time, been painted with mineral paint, and the artist had decorated the lower part of the frame. The armature being in contact with the frame, grounded the machine.

On the 9th inst. licenses of incorporation were issued by the Secretary of State to the Citizens' Electric Company, of Chicago, with a capital stock of $500,000, of which Wm. A. Comstock, Chas. C. Doolittle and Ray Sturtevant are incorporators; and the Bain Electric Manufacturing Company, at Chicago; capital stock $100,000. Force Bain, Edward L. Upton, and Jewell K. Philo, incorporators. Both of these are electric-light enterprises.

Col. Lynch, at 144 La Salle, reports telephone stocks, as follows:

Central Union	$ 55	@	57
Michigan	68	@	70
Iowa Union	20	@	23
Great Southern	50	@	55
Rocky Mountain Bell	50	@	55
Chicago	375	@	400

CHICAGO, Sept. 15, 1885.

EUGENE PHILLIPS' CLAM-BAKE.

THE ELECTRICAL FRATERNITY ROYALLY ENTERTAINED BY THE AMERICAN ELECTRICAL WORKS, AT PROVIDENCE.

The annual clam-bakes provided by Eugene Phillips, president of the American Electrical Works, of Providence, R. I., have become historic, and are attended by his electrical friends from all parts of the continent. The seventh was celebrated at the Vue de l'Eau Club, Friday, Sept. 11th, and as will be seen by the list published below, was largely attended. This club's headquarters are located on one of nature's beauty-spots, a short ride down the Narragansett Bay, where the scenery is attractive and inspiring. From 10 A. M., until 6 P. M., the electrical guests were present, and without any restrictive formalities participated in the enjoyment of the occasion, entering into the games of baseball, football, clay pigeon shooting, and "lung testing," with a zeal that resembled that of a party of school-boys on a vacation.

Each guest on arriving was asked to register, and was then presented with an unique and appropriate souvenir in the shape of a cane, the head of which consisted of a model of a telephone receiver, with a clam shell attached to the cords. The cane was the idea of Mr. Fred. Angell of the American Electrical Works, and was a very happy and original conception. An elegant lunch and cigars were found waiting the disposition of the visitors as soon as they arrived, the clam-bake being discussed at 3:30 o'clock. Meanwhile the handsome grounds surrounding the club-house were alive with games, in which staid business men participated with an abandon that suggested boyhood days. In the baseball matches the only unhappy persons were the umpire and scorer, and the latter, after using all the paper he could find, in an honest effort to make a complete record, gave up in despair and drowned his sorrows at the fountain of Roman punch. The umpire, we are pleased to state, after several narrow escapes, came away unharmed, and we trust will be alive to tell the tale of his thrilling adventures to many future bakes. Football was the most generally patronized, and this may be accounted for from the fact that most of the participants were telephone men whose acquaintance with irate subscribers had made them familiar with "kicking in all its branches." There was a simple and innocent-appearing machine that occupied a corner in the club-house, which furnished more amusement in proportion to its size than any feature of the day; it was known as the "lung tester;" but it went further than that, and was a complete test of how much flour the victim could blow into his eyes and hair and down his neck, before discovering that he was furnishing amusement for the crowd which was applauding his efforts with a heartiness that at times threatened to raise the roof. It was a very deceptive "tester." One in the secret could easily blow 70 pounds, but when his opponent, unaware of his fate and with a sincere desire to prove worthy of the trust that enthusiastic friends were evidencing by large odds in favor of the strength of his lungs, would commence to blow, a valve would be slyly turned and before 10 pounds could be reached, a small Vesuvius of flour would almost smother him, and life, that a moment before was bright and joyous, would literally become a howling waste, peopled with yelling fiends who would consolingly tell him that he "had blown the top off." One of the first victims was C. S. Thompson, of the American District Telegraph Company, of Brooklyn, closely followed by Jesse Bunnell and others, who arrived on the ground ignorant of the peculiarities of the "lung tester." There was nothing for the victim to do but to take it good-naturedly, and scrape out the flour, and then he became the most enthusiastic in the endeavor to secure fresh innocents.

At the bake in the large hall of the club, Mr. Phillips read letters of regret from the Governor of Rhode Island and the Mayor of Providence and Stephen D. Field, the latter which was in a humorous vein being greeted with applause. Then on behalf of the host, Mr. R. W. Pope of the *Electrician*, welcomed the guests in a brief and appropriate address, and then for nearly two hours the excellencies of the clam-bake were discussed. All who have attended one of these clam-bakes know what this means, and those who have not never can until they do.

The entire party were photographed, a very excellent picture being secured, a copy of which was ordered by nearly ever one present. At 6 o'clock "Auld Lang Syne" was sung, and then three cheers and a tiger were given for Mr. Phillips, the boat returning to Providence a few moments later, with as thoroughly tired and as thoroughly happy a party as ever attended a clam-bake.

On the return a bright little baby on board attracted the interest of the party, and was, by consent of the parents, duly named "Katharine Electricity Sullivan," the telephone men acting as sponsors.

In the evening Mr. Phillips kept "open house," and all who could visited his home and enjoyed a delightful social evening.

Telephonic News

⁂ A telephone line from Gallatin, Tenn., to Scottsville, Ky., is now in course of construction.

⁂ The Egyptian Government has authorized the establishment of a telephone line between Cairo and Alexandria.

⁂ Mr. Davis Vail, father of T. N. Vail, of Boston, died last week at his son's residence. He was a prominent citizen of Waterloo, Iowa, and seventy-four years of age.

⁂ The Italian Minister of Public Works has consented to the formation of the "Societa Romana Co-operativa del Telefoni," which unites the two rival telephone companies hitherto existing in Rome.

⁂ It is the intention of several firms in Boston to test by concerted action the right of the telephone company to refuse to give out private line instruments in that city unless the company owns all the lines.

⁂ Scene: Lady and gentleman examining telephonic apparatus at the Electrical Exhibition. He: "Do you know, dearest, how this works?" She: "I've no idea." He: "It is simplicity itself; you hold the apparatus with one hand whilst you speak with the other! ! !"

⁂ In St. Petersburg, Russia, poles are not permitted in the city, and all telephone wires are carried on housetop fixtures, the fixtures being made of iron exclusively. The instruments used by this company—the International—are all manufactured in Antwerp, and the wire used is No. 14 steel.

⁂ At Stockholm, Sweden, the telephone wires extend to the water's edge, and as soon as a vessel arrives a telephone is placed on board at once, giving all on shipboard connection with the entire exchange. This is quite an advantage, and is an accommodation that is greatly appreciated, particularly by the hotels of Stockholm.

⁂ Gen. C. H. Barney, the managing director of the Middle States of the North, Central and South American Exposition at New Orleans is division superintendent of the New York and New Jersey Telephone Company. He was commissioner from New Jersey at the late New Orleans Exposition, and was formerly Adjutant General of Rhode Island.

⁂ The Electrical Subway Commission in New York has been shown many plans for burying the wire. The estimated cost of the several devices varies widely. One man offers to furnish and bury a cable of one hundred wires for $10,000 a mile; another would like $31,000 a mile for a conduit alone; while another proposes to build a 25,000-wire conduit, six feet by 8½ feet, at $65,000 a mile, or he will give you one ten feet wide for $95,000 to $110,000 a mile.

⁂ The Chesapeake and Potomac Telephone Company have filed their answer to the equity bill of Curtis J. Hillyer, in which he prays that the company be enjoined from erecting poles on which to string their wires in alleys in Square 195, of which he claims to own the greater portion. The company sets out that its plant and operations constitute a convenient and necessary means of intercourse between the government departments as well as among the inhabitants; that this means of intercourse cannot be maintained without using public highways in the manner complained of, and that the District Commissioners are fully empowered to authorize the erection of the poles. The company claims that the construction of the line through the alley cannot create a nuisance, will not be detrimental to public convenience, or dangerous to the buildings already erected in the square and bordering on the alley-way, and will afford means of increasing the value of adjacent property. The company expresses its willingness to pay any damage judicially ascertained to have been entailed by the erection of the line in the alley.

⁂ According to the rules under which the telephone companies are formed in Russia, 10 per cent. on private subscription, and 5 per cent. on those of municipal and Government corporations are paid over to the Treasury; 5,000 roubles in the capitals and 2,000 roubles in provincial towns being the minimum. In 1883 the revenue derived from this source exceeded 22,000 roubles, in 1884 it was about 25,000 roubles, while that for the present year is expected to reach 40,000 roubles.

⁂ The Chesapeake and Potomac Telephone Company, which operates in the territory of Maryland and the District of Columbia, has been divided into two divisions, the District of Columbia comprising one division and Maryland State the other. Mr. A. Wilson, Jr., formerlp superintendent at Baltimore, now assumes charge of the entire State, and the exchanges at Cumberland, Hagerstown, Frederick and other points will be under his immediate supervision. His office will be at No. 121 West Baltimore street.

⁂ The operations of the New England Telephone and Telegraph Company in June and the first six months of 1885 were:

	June.	Since Jan. 1.
Gross receipts	$77,331.60	$462,959.55
Gross expenses	55,608.82	324,369.21
Net earnings.....	21,722.78	138,590.34
Construction.....	6,985.63	46,352.87
Surplus.....	14,737.15	92,237.47

The above shows average gross receipts per month of $77,159.92; average expenses, $54,061.53; average net earnings, $23,098 39; average construction expenditures, $7,725.47, and average surplus, $15,372.91.

⁂ A recent interesting exhibition of apparatus in Paris, by Dr. Boudet, including modifications of the telephone, adapting the instrument to a variety of medical uses. In one form the pulsations of blood vessels and all sorts of internal operations were very strikingly made audible, the observer being able to hear at will the movements in any part of the body. Another telephonic appliance detected the presence of stones in the bladder, and even made known their character when present. Dr. Boudet also employs the telephone as a measuring instrument for accurately estimating the nervous and muscular excitement in the different phases of a disease.

⁂ President Charles F. Cutler, of the New York & New Jersey Telephone Company, desires to have the following published, the case referred to being of considerable interest: "The Domestic Telephone Company filed a bond for $25,000 in the Court of Chancery, Aug. 31, to secure the New York & New Jersey Telegraph & Telephone Company from loss pending an injunction which restrains the latter from interfering with the rights of the Domestic Company, until the chancellor shall have decided the suit between the two companies for the possession of the Newark Company's property. The case was recently decided against the Newark Company, and the decision was sustained by the Court of Errors, but a new trial was granted on an amended bill."

⁂ Watson Van Benthuysen, president of the National Improved Telephone Company of New Orleans, states that suit has been instituted in the United States Court at that city to annul both of the Bell patents. The other petitioners, aside from the president of the company, are Chas. P. Huntington, of Mississippi; J. R. Beckwith, of New Orleans, and George Gantt and others of Memphis. It is claimed by the petitioners that overwhelming evidence proving that Bell did not discover the art of transmitting speech by electricity or invent the telephone will be presented during the trial. It was upon said evidence that the District-Attorney submitted the case to the Department of Justice at Washington, and applied for permission to institute suit in the name of the government to annul the Bell telephone patents. Messrs. Beckwith of New Orleans, and Casey Young and General Wright of Memphis, have been appointed special government attorneys to assist in prosecuting the suit. Only two or three similar litigations have ever been tried in this manner.

⁂ General Superintendent John Crawford, of the International Telephone Company of St. Petersburg, Russia, has returned to this country to remain. In the city of St. Petersburg there are 880 telephone subscribers; in Moscow, 570. Rentals are 250 roubles (about $125) per annum. The company has a monopoly of the business, granted by the Government, for a term of 20 years.

⁂ The following is a statement of financial operations of the New England Telephone Company for the six months ending June 30, 1885:

Gross earnings.....	$462,959 55
" expenses, ...	324,369 21
Net earnings.....	$138,590 34
Construction	46,352 87
Net	$92,237 47
From this should properly be charged six months' taxes, estimated at	$18,000 00
New office	48,000 00
Total to be deducted	$66,000 00
Capital.....	$5,895,600 00
" A. B. franchise.....	1,320,000 00
" Sept. 30, 1885.....	$7,215,600 00
" A. B. franchise.....	600,000 00
" Oct 1, 1885.....	$7,815,600 00

⁂ A complaint has been filed against the Central Union Telephone Co. at Indianapolis, stating that D. M. Bradbury had made a demand upon the company to place a telephone in his office at the legal rate of $3 per month, which was promptly refused. The defendant, therefore, asks that the company be compelled by law to supply Mr. Bradbury with a telephone at the rate fixed by the legislature. The complaint has been filed to test the constitutionality of the law; and it is understood that the defence will be conducted by McDonald, Butler & Mason, and Baker, Hord and Hendricks; while Messrs. Calkins & Harris, and Byfield & Howland will conduct the case. The points involved are chiefly the following: (1.) It is unlawful to charge over $3 per month. (2.) It is unlawful to charge more than fifteen cents for a five minutes' talk between two towns, and lastly, the company must treat all patrons alike, and make no discrimination among persons.

⁂ The American District Telegraph Co., of Buffalo, which is owned by the Bell Telephone Co., has taken hold of the Baltimore & Ohio telegraph delivery department. A quarrel between the Bell Telephone Company and the Western Union, immediately ensued. Mr. Tillinghast, manager of the Western Union, claims that his telephone, number 398, was cut out, and that it was two hours before he could do anything with it. The Western Union Company has a contract with the American Bell Telephone Company, the parent organization, by which it may send and receive messages, a matter outside the control of the local telephone company. In order to find out first what was in the wind, Mr Tillinghast sent one of his "special" messengers over to the telephone office to inquire what was the matter, with orders to bring back the exact words. When the boy returned he brought back the reply that the general manager had given orders not to make any connection with the Western Union, except for people who desired to send telegrams. Mr. Tillinghast then wrote a let er to General Manager Cowles, calling for an explanation. Mr. Cowles called at the Western Union office and claimed that his orders had been misunderstood. He promised to modify the order he did give, and said that the Western Union could have connection with all the patrons of the company. After a while Mr. Tillinghast called up the central telephone office and asked the operator what his orders were in regard to the Western Union telephone. The reply was that they were instructed to give the Western Union any connection it desired, but if any subscriber was called by the Western Union office, the operator was instructed first to inquire if they desired to send a telegram. If that was not the purpose of the connection they were to decline to make it.

⁂ All British telegraph lines being in charge of the Post-office Department, the Postmaster-General has assumed that messages cannot be sent by telephone. He will not even allow the clerks at hotels to write out a word received for a guest. Either the guest must come to the tube or the message must be repeated to him verbally.

⁂ The American Bell Telephone Company has declared a quarterly dividend of 3 per cent., payable Oct. 15 A believer in the Company writes: "Touching the matter of telephones, it has recently been stated that the output has increased slowly during the past six or eight months, being but a few thousand, with the chances for a large proportionate increase for the balance of the year still in doubt. Notwithstanding this fact, we find upon inquiry that the company is earning 20 per cent., even if there should not be another telephone added the balance of the year. Their recent action towards the sub-companies must enhance the value of their large holdings in those companies, making the value of the stock less dependent upon it earning capacity, which heretofore has been considered it chief asset. The time must come when such large earnings will be better appreciated. At to-day's price Bell stock is selling at less than 60 on the basis of 6 per cent. earnings. It would be difficult to find a property on public sale, with such earnings, selling at such a price. Compared with the eastern railroad stock selling at 53, and New York & New England Railroad at 23, the dividend prospects of which have been well discussed, the price seems ridiculously low. Truly it seems at times that it is the amount of attention given to a security by the brokers which makes or unmakes its market (not its intrinsic) value.

The following from the *Commercial Bulletin*, of Boston, will be interesting:

"The Pan Electric Company are making rapid strides, especially in Texas. We hear that at Fort Worth, Dennison, and one or two other places, they have about ruined the Erie Companies' business, and that they are now starting in Dallas and other important places, which the Erie have heretofore depended upon for an income in Texas."

Texas Telephone News.

Editors of the Electrical Review:

DEAR SIRS:—Yes, the Southwest is still alive, and—the telephone subscribers—kicking. There's no denying that there has been a sort of somnolescent tendency during the summer months, but a pin stuck into the right place would have shown evidence of life. Now that the autumn hath come, turning green to gold, the cotton ball spreads forth its fleecy burden, and the wheels of trade begin to turn more swiftly. The awakening has come. The revival affects the telephone interests favorably, and the lost victims begin to return. Orders are coming in at a lively rate at Galveston, and, presumably, throughout the State. Erie prospects seem exceptionally bright in this district, notwithstanding the fact that Tom Skinner, the old-time telegrapher and fire-alarm man, has embarked in an opposition telephone scheme. Tom doesn't know volumes about telephone patents, and has, during probably a momentary aberration, gotten hold of "an instrument superior to Bell's, which is in nowise an infringement upon any other patent," and is, during a continuance of the mild malady, rustling around to find investors. He calls it the Long telephone, of Washington. There are none on the ground yet, and I have to confess and deplore an ignorance of the existence of such a machine. There are several hundred patented "improvements," among a closet full of papers up home, and, may be, if I take a day off some time, I can find the "Long" duly noted. I have been told that the scheme depended upon securing a loan of twenty thousand dollars; if this be true—so Long.

The Pan Electric Telephone chaps still continue to bob about in the vicinity of Fort Worth and Dallas. The hearing, which is to come off in Baltimore September 15th, of the

American Bell *vs.* the Pan Electric, doesn't seem to overawe them much. Well, fellows who are gifted with as much natural gall as at least one of the active members of the Pan family wouldn't "awe" appreciably at anything less than an earthquake. And, as for as prevarication—well, he just simply "takes the bakery." But these little side issues will soon be wiped out, and the economy practiced in the management of the Erie is bound to tell on the price of that stock. We don't want it to boom. One boom in the lifetime of a telephone company is as much as the most patriotic employee can be expected to pray for. Leave the "r" out and you'll catch the idea.

You probably read the telegraphic report of a strike among the operators in Galveston. Well, four fellows got on a "high lonesome" one Sunday and applied to Manager Chesley for money with which, presumably, to obtain more "tangle foot" and "bull," causing hop juice, but Chesley thought they were full enough for that time, and refused to shell out. They then demanded their "time," which was also refused; whereupon they secured an ear of a *News* reporter, and proceed to fill *him* full. He chronicles a strike next morning, and the emissaries of other newspapers telegraph the lurid particulars over the broad land. Result: The B. & O. Telegraph Company do a rushing business until the facts are known to the business people, and two of the "strikers" find employment with the opposition.

Give you a rest? Oh, certainly.

G. W.

BOSTON, SEPT. 7, 1885.

Editors of the Electrical Review:

The following statement shows that an earned dividend of one per cent. can hardly be expected from the New England Company in October, as the figures will show that hardly two per cent. per annum can be earned at this rate, and we have thrown out the $48,000 for new office, which must be paid some time As we remarked in our last letter, it is doubtful if the next six months will show as well as the last have; be-ides, in December, the Bell Company come in for another slice of the capital stock, and pretty soon a capital of ten millions will be entitled to dividends. Can the most sanguine friends of New England figure out where it can increase its net earnings from less than $13,000 per month, now, to over $40,000 per month within a few years? That is what must be done to pay five per cent. on the $10,000,000. Say nothing about $12,000,000 which they expect to have in 1891.

With a demand for underground wires staring them in the face, isn't it about time the Bell Company made some arrangements by which the New England stockholders can expect at least a small return for the money and faith they put into the business to start it? Unless something is done you will see such legislation next winter as will be anything but pleasant to our Milk street friends.

The following is a statement of financial operations of the New England Telephone Company for the six months ending June 30, 1885:

Gross earnings	$462,959.55
" expenses	324,369.21
Net earnings	$138,590.34
Construction	46,352.87
Net	$92,237.47
From this should properly be charged six months' taxes, estimated at	$18,000.00
New office	48,000.00
Total to be deducted	$66,000.00
Capital	$5,895,600 00
" A. B. franchise	1,320,000.00
" Sept. 30, 1885	$7,215,000.00
" A. B. franchise	600,000.00
" Oct. 1, 1885	$7,815,600.00

.... A poor fellow, seeking employment in a Chicago telegraph office, finally asked to be hired as a telegraph pole. It was no use, every post was full.

The First Telegraph.

PLOWING TO LAY THE WIRE—ODD DEVICES USED BY THE INVENTOR.

"The Elecric B. & O.," by Major J. G. Pangborn, contains an interesting account of the building of the first line by Mr. Morse, under the patronage of the Baltimore & Ohio Railroad. "There are still living quite a number of the railroad employes who remember the preliminary proceedings, and who were frequently in consultation with Mr. Morse himself, as well as those engaged with him in the work. They all agree the matter of poles was not mentioned at first, and the discussion confined to the underground plan. Mr. Latrobe says the line was to have been laid in a trench dug in the road-bed, and in none of the reports where mention is made is the question of poles referred to. The probabilities are that the stretching of wires above ground was not considered until the plow with which the trench was made, not upon the road-bed, but on the company's right of way, reached Relay and the viaduct at that point

"Here it was impossible to continue, as the viaduct was of stone, and as a matter of course not to be plowed. The carrying of the line so as to be out of the reach of the curious and mischievous necessitated its being run over the viaduct on poles. However, before this emergency arose, the buried section became practically useless, as the current could not be maintained, and all the money spent, some $12,000 of the $30,000 appropriated, was as good as thrown away.

"Luckily it was no more, and with the assistance so freely extended by the railroad company, in the way of machinery and transportation, the crisis was averted. The plow by which the line was laid from Baltimore to Relay was a ponderous inplement, showing no ordinary ingenuity in its construction. The plowshare was cast by the present foreman of the moulding-room at the railroad company's shops at Mount Clare. It made a furrow two inches wide and twenty inches deep, feeding the leaden pipes, in which the wires were encased, from the bottom.

"In the top of the beam of the plow was a cylinder holding some sixty feet of the pipe, which uncoiled and passed down over little pulleys in the rear edge of the blade of the plow to the earth, uncoiling the line, as heretofore stated. A plumber, with his fire-pot and soldering irons followed immediately in the rear, and as the supply on the cylinder ran short, would step up, wind on a new section, wipe or join the ends, and thus keep up the operation of laying the line.

"The propelling power was in sixteen immense oxen, and the 'Woa, there,' 'Gee, you,' and like commands, not unmixed with imprecations, together with the novelty of the whole affair, created no end of excitement for the denizens of the country traversed. It was quite the thing for Baltimore people to ride out on horseback of an afternoon and inspect the progress of the lightning catchers, as many called Morse's men.

"Numberless were the interrogatories put to those in charge, and had injunctions been as fashionable then as since, about every foot of the way would have to have been contested in the courts. Barns which were anywhere in close proximity to the line were considered in the greatest danger, while not a few of the badly frightened farmers slept illy of nights that happened to be dark and stormy.

"Those who had all their lives been habituated to behold the lightning flashes in the sky, now expected it to shoot out of the ground at the most inauspicious moment, for, to do their best to allay apprehension, the belief in lightning and electricity being one and the same thing, would, like Banquo's ghost, not down. Subsequently, when the wires were strung on poles, the feeling did not vanish, but for some time continued. It was claimed the birds would all be killed, and dire consequences follow the freaks of the electric fluid from the clouds when it met the electric current on the wires, and the two commenced a waltz of mutual exhaustion.

"The complete model of the Morse plow, on exhibition in the Baltimore & Ohio display at the New Orleans Exposition, attracts no ordinary attention, and to very many visitors, telegraphers as well as others, is in the nature of a revelation, it not being generally known that the original telegraph line was laid underground. Also in the exhibit in the Crescent City is a model, showing the construction of the original Morse line after the trench plan had been abandoned. To establish the electric current a wire connecting with the pole of the battery was soldered in Baltimore to a sheet of copper five feet long, two and a half feet wide, and thrown into the harbor."

.... Captain E. de Vasconcellas is now in England representing the Portuguese Government at the Silvertown works during the construction of the Northern sections of the West African Cables, which will shortly be completed.

.... In the case of Pennington *vs.* Western Union Telegraph Company, decided by the Iowa Supreme Court, it appeared that the plaintiff's agent telegraphed him an offer to buy apples at $2 per barrel, but by the negligence of the agents of the telegraph company the telegram was not properly copied. Plaintiff took no notice of it and afterward the price of apples advanced, and in purchasing he was obliged to pay the advanced price. Thereupon he brought suit against the telegraph company for his loss. The court held that he could only recover the amount paid for the telegram. The court cited the opinion of the Supreme Court of Wisconsin in another case against the Western Union Telegraph Company to the effect that "profits on a contract never made are quite too remote and uncertain to be taken into consideration," and said: "In the case at bar the plaintiff merely lost an offer, and if we were to apply the rule above mentioned, it would be clear that the plaintiff could not recover more than the cost of the telegram.

.... Mr Richard A. Procter, the popular lecturer on astronomical and other scientific subjects, writes to the London *Times* as follows: "Out of 15 transatlantic telegrams which I have had occasion to send, or to have sent me, during the last six years, three have miscarried. This is too large a proportion of failures, and the public ought to know how much or how little they can trust transatlantic telegraphy as at present conducted. Here are, in brief, the particulars of the three failures and of the compensation—save the mark!—made by the persons responsible. In the summer of 1879 I dispatched from the office near Burlington House a telegram to my lecture agent in New York on important business, telling him to wire reply. No reply coming, I wired again, and was told no message had been received. For compensation I received expressions of regret and the price of the original message. Last June I wired from St. Joseph, Mo., to my lecture agent here, in reply to a telegram of his on important business. Late in July I received a letter from him saying that the telegram referred to in my letters had not been received. I found it had got as far as London, but had not been forwarded. For compensation I received very courteous expressions of regret from the head Post-office, with suggestion that I should write to St. Joseph for return of the price paid for the telegram. On August 6th, at 11:30 A. M., I wired from Liverpool (office under North-Western Hotel) a message to St. Joseph, Mo., in one word, but that word announced my safe arrival, and gave instructions on a business matter of importance to my wife. I have to-day received a letter from her, dated August 8th (not a mistake, for she mentions that guns were firing, etc., because it was the day of General Grant's funeral), from which I learn that my telegram, sent off at 5:30 A. M., St. Joseph time, on August 6th, had not been received at mid-day on August 8th. I do not yet know what compensation, if any, will be offered. Possibly the telegram may have been since delivered—on August 16th, for example, in which case no compensation need be expected."

TELEGRAPHIC

.... The subject of the durability of wires has arisen many times of late, and it has been the universal testimony of experts that the average life of a telegraph or telephone wire is not over six or eight years.

.... Old Mr. Bently—"I see that at the base ball game yesterday the home club put in its strongest battery."

Old Mrs. Bently—"You don't tell me. I wonder what they'll do with electricity next."

.... Under the new telegraph rates in England a person who writes the figures 1885 pays for four words; if he writes "eighteen eighty-five" he only pays for two. Other words count similarly, as "thirteenth" is one word, and "13th" counts as three.

—— They still complain of the bugs attracted by the electric light in New Orleans. The electric-light company has promised to remove further cause of complaint by having the lamps suspended over the middle of the streets.

.... Work on the Southern Telegraph lines was resumed some days since. The company's purpose just now is to complete the gap between Meridian and New Orleans, and the line will probably be pushed to the Crescent City by the 1st of October next.

.... About 100 gentlemen, comprising representatives of Glasgow, Liverpool, Belfast and Londonderry shipowners, visited Tory Island recently, and, having examined the island, passed resolutions in favor of establishing telegraphic communication between the island and mainland, and urging the Government to afford this communication.

.... The gentlemen attending the Telegraph Conference at Berlin are having a very enjoyable time, judging from the number of banquets tendered them. United States Minister Pendleton was present at the last one. The court theatrical troupe played "Electra," which was written especially for the occasion by Herr Wildenbruch.

.... The Eastern Telegraph Company announce the laying of the duplicate cable between Zanzibar and Mozambique, by the S. S. "Seine," belonging to the Telegraph Construction and Maintenance Company. The line has been laid with the view of improving the service and to guard against future interruptions of communication with South Africa.

.... A story comes from San Francisco of the death, in utter destitution, of a once telegraph operator, who amassed a fortune of ten millions of dollars through discovering the key to the cipher employed by the four Bonanza Kings in their frequent inter-communications respecting the silver mines in California and Virginia. He speculated and won, and then speculated and lost.

.... The stockholders of the Erie Telegraph and Telephone Company held a special meeting at Albany, N. Y., last week, to take action concerning the purchase by its former directors or Executive Committee of the South-eastern Dakota Telephone and Telegraph Company and the Arkansas Telegraph Company. J. W Bennett, in a brief speech, stated the object of the meeting, and a resolution was offered authorizing Directors Bennett, Adams and Jewell to inquire into the circumstances of the purchase and bring suits, if thought advisable, to recover any moneys which may be found to be due to the company. M. F. Dickinson, Jr., of Boston, representing himself and other stockholders, attacked the proposed resolution, claiming that the purchases were made in good faith and openly, all the transactions being recorded on the books of the company, and hinting that the real object of the meeting was to influence public sentiment against the former directors, and perhaps affect private suits brought by several of the present directors against members of the Lowell syndicate, soon to be tried at Lowell.

Additional Notes on the Telephone Convention.

The Providence papers were permitted to have representatives present during the convention, and very excellent reports of the proceedings were published each day. This is a new departure for the Telephone Association, and one that should have been adopted sooner.

Mr. E. T. Gilliland was warmly greeted by all, and the regret was universal that he should have decided to leave the telephone field the first of October.

Mr. Durant's drawing, which showed the relative extent and proportion of all the various classified expenses of the telephone business without the aid of a single figure, attracted much notice. Mr. Durant had with him, also, a sample of all the blanks in use by his company.

Thursday morning, before the discussion of Mr. Carty's excellent paper on the "Multiple Switchboard" commenced, Capt. Stone, of Cincinnati, stated that he thought the *minutes* which were named in one of the papers as occupied in making ten consecutive connections, should be *seconds*. This slightly sarcastic remark the Captain explained by stating his doubts of the correctness of the time quoted in the paper which had made Cincinnati the slowest of any of the exchanges in the time required for ten connections. All who have ever visited Cincinnati, we may add, will find the most contented and satisfied, as well as proportionally large list of subscribers to be met with anywhere in this country, and, fast or slow, that is the happy end desired. After Mr. Carty's paper, which gave an excellent description of the results obtained by the multiple system in Boston, Mr. Lockwood gave a sketch of the litigation during the past year with reference to patent rights. Among them were the suit of the People's Telephone Company, and injunctions against the McDonough, Molecular, Overland, Western Penn, while the Pan Electric Company are the most active infringers, and are now being sued. The decisions favorable to McDonough have been reversed in favor of Bell. The Dolbear Co. have entered an appeal against the decision of the United States Court, so that the American Bell Co. may be said to possess almost a clear field.

Mr. Durant suggested that, in view of the prospect of compulsory legislation another year in regard to underground wires, that it would be advisable to have an extra number of copies of the papers on this subject printed for distribution.

The association tendered a vote of thanks to the Providence Telephone Company, through its representatives, Governor Howard, General Manager Duxbury, Superintendent A. C. White, Treasurer C. T. Howard, and President Phillips, of the American Electrical Works, for their hospitality and courtesies extended during the sessions of the Convention, and also to the press of the city for their full and excellent reports of the proceedings.

Mr. Metzger, of Pittsburgh, invited the association to meet in that city in September, 1887.

During the progress of the Convention the Electric Time and Messenger service of this city has been at the disposition of the association, by the courtesy of General Manager Charles G. A. Peterson.

Messrs. Washburn & Moen exhibited a case of their hard-drawn copper wire, which attracted much favorable comment.

The complimentary excursion on the steamer Philadelphia, chartered by the Providence Telephone Company, started soon after the adjournment of the convention, a number of the ladies attending the convention accompanying the party. The steamer started about 1 o'clock and sailed leisurely down the bay, the several points of interest on sea and shore being described to the visitors, and the whistle blast being called into frequent requisition in response to passing compliments. A substantial collation was served on the passage by Caterer Ardoene, which was attentively discussed, while an abundance of cigars were distributed at intervals during the trip. The ladies were invited into the pilot house, and were thus protected from the cool temperature, although after passing Rocky Point, the sun shone brightly, and the excursionists were comfortable without the employment of overcoats. The course lay past the Point to the entrance of Greenwich Bay, and then back to Mount Hope Bay into Bristol Harbor, and this portion of the sail was delightful, the visitors frequently expressing their enthusiastic admiration of the picturesque scenery along the western shore. After circling the bay, the way lay direct to the city, the steamer reaching her dock at the appointed hour—5 o'clock—and the party, upon landing, took the opportunity to express their grateful appreciation of the courtesy of the company in offering such a pleasurable entertainment. Upon the invitation of the officers of the Providence Telephone Company, the delegates visited the headquarters in Butler Exchange, and were taken through the several departments, finding much of interest and instruction in the inspection of the system in operation.

One feature of the excursion, besides the splendid collation, was a very palatable and mild punch that was free to all who visited the bar. The boat at one point scraped a rock, and the inquiries of the ladies as to the cause of the noise was answered with the statement that the boat had "struck a bar." "That's nothing," promptly replied the witty wife of a Southern telephone man, "my husband has been striking a bar every fifteen minutes!" The husband immediately proceeded to "strike the bar" again, closely followed by laughing friends.

The New England Butt Company, of Providence, had on exhibition two of their interesting braiding machines, for covering telegraph, telephone and electric-light wires. These machines were quite an object of notice, and showed to all the method of covering the wire done so easily, yet by machines of very complicated parts. This company is doing a splendid business in this line.

Messrs. Armington & Sims, the widely-known engine men, sent a number of very tastefully printed invitations to the members of the Telephone Convention, and several availed themselves of the opportunity to visit the extensive works of these very successful engine builders. They are exceedingly busy, notwithstanding the depression, and, if they were not to receive an order for three months, have orders ahead enough to keep the full force at work all that time.

Mr. Geo. L. Wiley represented the Standard Underground Cable Company at the convention, having on exhibition a big lot of cable samples. These cables were particularly noticed by the telephone people, as the Waring cable has the best of endorsement, and then, besides, Mr. Wiley is one of the best-known ex-telephone men in the East, and at once was welcomed among the telephone hosts.

Mr. Clark B. Hotchkiss, representing the Day's Kerite insulated wires and cables, was a prominent representative at the convention, remaining until its close. Parties interested in the underground problems found Mr Hotchkiss a source of much valuable and reliable information, and he was continually interviewed by the telephone men present.

The paper of Mr. Patterson, inventor of the Patterson cable, is given in full in this edition, and is worthy a careful and thorough perusal.

The visit to the large establishment of the Brown & Sharpe Manufacturing Co. was greatly enjoyed by the telephone men. Mr. Sharpe escorted the visitors in person through the varied departments of this model manufactory.

Col. Goodyear, of E. S. Greely & Co. (formerly Tillotson & Co.), arrived Thursday, and remained until after the clam-bake. Mr. Jesse Bunnell reached Providence too late for the convention, but in time for the clam-bake and the "lung tester."

Mr. R. K. Dana, of Washburn & Moen, New York, came over Wednesday, and remained during the convention. It is to be regretted that he did not arrive in time to participate in the discussion, Tuesday, on wire gauge, as he could have given some very valuable points in relation to this matter.

FIG. II.

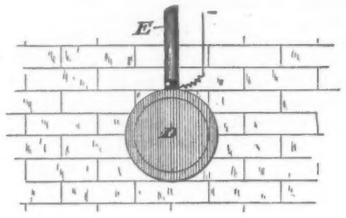


FIG. III.

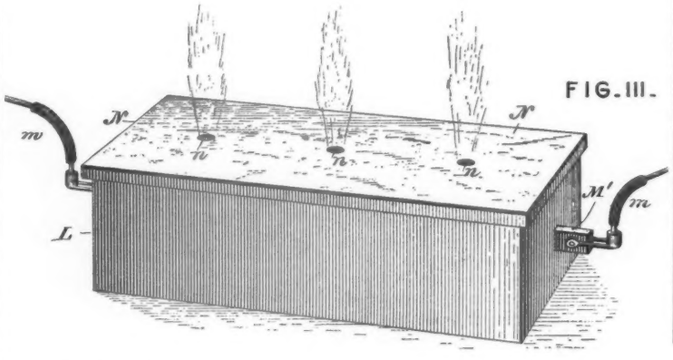


FIG. IV.

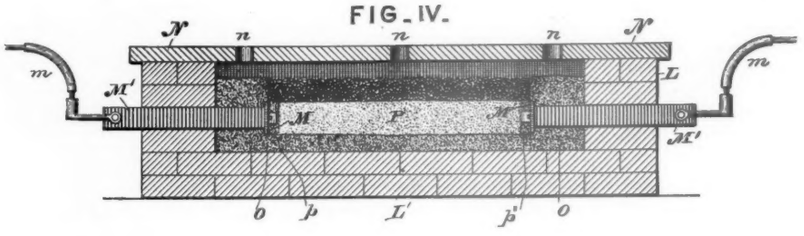


FIG. V.

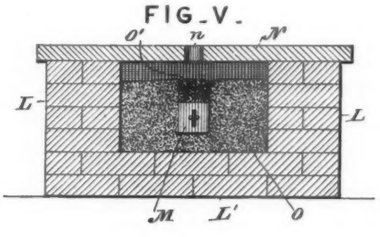
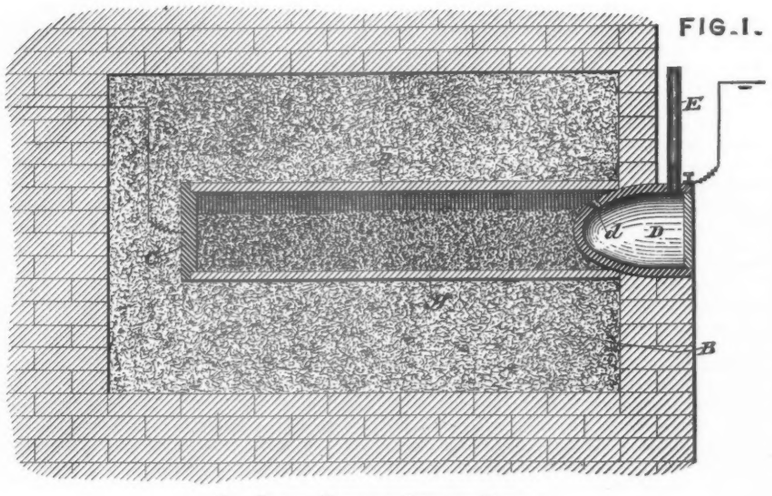


FIG. I.



THE COWLES ELECTRIC SMELTING PROCESS.

The Cowles Electric Smelting Process.

There is much interest being taken in everything bearing on electro metallurgy, and other applications of electricity, in mining and metallurgy. In this connection, we illustrate the process of the Cowles Electric Smelting and Aluminium Company, of Cleveland, Ohio. The *Engineering and Mining Journal*, of this city, the best of authority in such matters, in speaking of this use of electricity, particularly of the Cowles process,

says that the use of electricity in the reduction of metals from their ores is extending so rapidly, and the methods of its generation and application have been so greatly improved within a few years, that the possibility of its becoming the chief agent in the metallurgy of the future may now be admitted, even in cases where the present cost of treatment is too high to be commercially advantageous. "The refining of copper and the separation of copper, gold and silver by electrolysis," the *Journal* continues, "have thus far attracted the greatest amount of attention, but a commercial success has also been achieved in the dry reduction by electricity of some of the more valuable metals by the Cowles Electric Smelting and Aluminium Co., of Cleveland, Ohio. Both this method of manufacture and the qualities of the products are so interesting and important that it is with pleasure we call attention to them as steps toward that large and cheap production of aluminium that the abundance of its ores and the importance of its physical properties have for several years made the unattained goal of many skillful metallurgists. The Messrs. Cowles have succeeded in greatly reducing the market value of aluminium and its alloys, and thereby vastly extending its uses, and they are now by far the largest producers in the world of these important products. As described in their patents, the Cowles process consists essentially in the use for metallurgical purposes of a body of granular material of high resistance or low conductivity interposed within the circuit in such a manner as to form a continuous and unbroken part of the same, which granular body, by reason of its resistance, is made incandescent and generates all the heat required. The ore or light material to be reduced—as, for example, the hydrated oxide of aluminium, alum, chloride of sodium, oxide of calcium, or sulphate of strontium—is usually mixed with the body of granular resistance material, and is thus brought directly in contact with the heat of the points of generation, at the same time the heat is distributed through the mass of granular material, being generated by the resistance of all the granules, and it is not localized at one point or along a single line The material best adapted for this purpose is electric light carbon, as it possesses the necessary amount of electric resistance, and is capable of enduring any known degree of heat when protected from oxygen, without disintegrating or fusing; but crystalline silicon or other equivalent of carbon can be employed for the same purpose. This is pulverized or granulated, the degree of granulation depending upon the size of the furnace. Coarse granulated carbon works better than finely pulverized carbon and gives more even results. The electrical energy is more evenly distributed, and the current cannot so readily form a path of highest temperature, and consequently of least resistance through the mass along which the entire current or the bulk of the current can pass. The operation must necessarily be conducted within an air-tight chamber or in a non-oxidizing atmosphere, as otherwise the carbon will be consumed and act as fuel. The carbon acts as a deoxidizing agent for the ore or metalliferous material treated, and to this extent it is consumed, but otherwise than from this cause it remains unimpaired."

In the illustrations of the Cowles process, which we deem of sufficient interest to present our readers, Fig. I. is a vertical longitudinal section through a retort designed for the reduction of zinc ore, according to our process, and Fig. II. is a front elevation of the same. Fig. III. is a perspective view of a furnace adapted to withstand a very high temperature, and Figs. IV. and V. are respectively longitudinal and transverse sections of the same. The retort consists of a cylinder *A*, made of silica or other non-conducting material, suitably embedded in a body *B*, of powdered charcoal, mineral wool, or of some other material which is not a good conductor of heat. The rear end of the retort-cylinder is closed by means of a carbon plate *C*, which plate forms the positive electrode, and with this plate the positive wire of the electric circuit is connected. The outer end of the retort is closed by means of an inverted graphite crucible *D*, to which the negative wire of the electric circuit is attached. The graphite crucible serves as a plug for closing the end of the retort. It also forms a condensing-chamber for the zinc fumes, and it also constitutes the negative electrode. The term "electrode" is used in this case as designating the terminals of the circuit proper, or that portion of it which acts simply as an electric conductor, and not with the intention of indicating the ends of a line between which there is no circuit connection. The circuit between the "electrodes," so-called, is continuous, being established by means of and through the body of broken carbon contained in the retort *A*. There is no deposit made on either plate of the decomposed constituents of the matter reduced. The mouth of the crucible is closed with a luting of clay or otherwise, and the opening *d*, made in the upper side of the crucible, near its extremity, comes entirely within the retort, and forms a passage for the zinc fumes from the retort-chamber into the condensing chamber. The pipe *E* serves as a vent for the condensing-chamber. The zinc ore is mixed with pulverized or granular carbon, and the retort charged nearly full through the front end with the mixture, the plug *D* being removed for this purpose. A small space is left at the top as shown. After the plug has been inserted and the joint properly luted, the electric circuit is closed and the current allowed to pass through the retort, traversing its entire length through the body of mixed ore and carbon. The carbon constituents of the mass become incandescent, generating a very high degree of heat, and being in direct contact with the ore, the latter is rapidly and effectually reduced and distilled. The heat evolved reduces the ore and distils the zinc, and the zinc fumes are condensed in the condensing chamber, precisely as in the present method of zinc-making, with this important exception, that, aside from the reaction produced by heating carbon in the presence of zinc oxide, the electric current, in passing through the zinc oxide, has a decomposing and disintegrating action upon it, not unlike the effect produced by an electric current in a solution. This action accelerates the reduction and promotes economy in the process.

Another form of furnace is illustrated by Fig. III., which is a perspective view of a furnace adapted for the reduction of ores and salts of non-volatile metals and similar chemical compounds. Figs. IV. and V. are longitudinal and transverse sections, respectively, through the same, illustrating the manner of packing and charging the furnace. The walls and floor *L L'* of the furnace are made of fire-bricks, and do not necessarily have to be very thick or strong, the heat to which they are subjected not being excessive. The carbon plates are smaller than the cross-section of the box, as shown, and the spaces between them and the end walls are packed with fine charcoal. The furnace is covered with a removable slab of fire-clay *N*, which is provided with one or more vents *n*, for the escaping gases. The space between the carbon plates constitutes the working part of the furnace. This is lined on the bottom and sides with a packing of fine charcoal *O*, or such other material as is both a poor conductor of heat and electricity—as, for example, in some cases, silica or pulverized corundum or well-burned lime—and the charge *P* of ore, and broken, granular, or pulverized carbon occupies the center of the box, extending between the carbon plates. A layer of granular charcoal *O'* also covers the charge on top. The protection afforded by the charcoal jacket, as regards the heat, is so complete that, with the covering slab removed, the hand can be held within a few inches of the exposed charcoal jacket; but with the top covering of charcoal also removed and the core exposed, the hand cannot be held within several feet. The charcoal packing behind the carbon plates is required to confine the heat and to protect them from combustion.

The *Engineering and Mining Journal* states that with this furnace aluminium can be reduced directly from its ores, and chemical compounds from corundum, cryolite, clay, etc., and silicon, boron, calcium, manganese, magnesium, and other metals are in like manner obtained from their ores and compounds. The reduction of ores according to this process can be practiced, if circumstances require it, without any built furnace. At present, the Cowles Company is engaged mostly in the producing of aluminium bronze and aluminium silver and silicon bronze. The plant, were it run to its full capacity, is capable of turning out eighty pounds of aluminium bronze, containing 10 per cent. of aluminium, daily; or, if it were to run upon silicon bronze, could turn out 120 pounds of that per day; or, we believe more aluminium bronze daily than can be produced by all other plants in the world combined. This production, however, is but that of the experimental laboratory, and arrangements are making to turn out a ton of bronze daily, and the works have an ultimate capacity of from eight to ten thousand horse-power. The energy consumed by the reduction of the ore is almost entirely electrical, only enough carbon being used to unite with the oxygen of the ore to carry it out of the furnace in the form of the carbon monoxide, the aluminium remaining behind. Consequently, the plant necessary to produce aluminium on a large scale involves a large number of the most powerful dynamos. These are to be driven by water-power or natural gas and marine engines of great capacity. The retail price of standard 10 per cent. aluminium bronze is $1 per pound avoirdupois, which means less than $9 a pound for aluminium, the lowest price at which it has ever been sold, yet the Cowles Company has laid a proposition before the Government to furnish this same bronze in large quantities at very much lower prices than this. The Hercules alloy, castings of which will stand over 100,000 pounds to the square inch tensile strain, sells at 75c. a pound, and is also offered the government or other large consumers at a heavy discount. The alloys are guaranteed to contain exactly what is advertised; they are standardized into 10 per cent., 7.5 per cent., 5 per cent., and 25 per cent aluminium bronze before shipment.

The current available at the Cowles Company's works was, until recently, 330 amperes, driven by an electromotive force of 110 volts, and supplied by two Edison dynamos; but the company has now added a large Brush machine that has a current of 560 amperes and 52 volts electromotive force.

— The *State Journal*, of Lincoln, Neb., gives the electric light the following words of welcome: "Last night the gas-lights which have for several years past illuminated the path of the benighted traveler upon the streets of Lincoln, folded their tents like the Arab and silently stole out between the wheels of the car of progress, on the front seat of which was seated the electric light. The lights are four blocks apart, and they seemed to average up with the gas-lights pretty well last night. It will be impossible to tell, however, until a dark night, just how successful the new light is, and it will take some time to form a correct judgment on the light from the fact that it differs so materially from the lights to which we have been used. It is certain, however, that they are much cleaner and clearer, and we believe they will prove perfectly successful."

— The city of Savannah, Ga., was in darkness for a few hours recently, owing to the supply of water being shut off unexpectedly in order to make some repairs to one of the mains, and consequently no steam could be made to run the dynamos. Superintendent Keck, with the assistance of Chief Engineer Fernandez, of the Fire Department, obtained a number of lengths of hose and formed a connection with a fire hydrant on Indian street, thus securing a supply of water for boilers during the night. The shutting-off of light, although it was wholly unavoidable, caused considerable annoyance in the market, which was insufficiently lighted during the market hours by candles and gas in the stalls. The side streets were dark as a pocket, and the absence of light caused them to be avoided by pedestrians. At 10 o'clock the lights were turned on again.

ELECTRIC LIGHT NEWS

— Mexico, Mo., is putting in a ten-light arc plant of the United States system.

— Mr. J. H. Reid is doing good work for the United States Electric Light Company in the West, having recently secured contracts for lighting in Mexico, Mo., and Eureka, Kansas.

— The report of the custodian of public buildings in St. Louis for August shows a saving of $536 for that month by the use of the United States Electric Light Company's incandescent light in Custom-House and Post-Office

— Mr. J. L. Barclay, one of the most popular young men in the electrical field, has been engaged by Holmes, Booth & Haydens. We know of no one who will receive a more cordial reception in the electric light field than Mr. Barclay, and we predict for him a good trade.

— The Richmond *Whig* says: "It is now a fact pretty well established that we will not have the electric light in time to illuminate the city during the fair. The work to be done in order to furnish the light is considerable. The poles have all to be placed in position, some in the middle of the street, as on Broad, and others on the edge of the pavement, with long arms reaching out over the street. The wires have to be stretched and all connections made, while it will require time to arrange the machinery. The Schuyler Electric Light Company, who contracted with the city to furnish the electric light, are pushing the work with all rapidity possible, and will use every endeavor to complete all arrangements just as soon as possible."

— The Hartford *Courant* has the following well-deserved mention of the Brush-Swan Electric Light Company and its management: "Mr. John B. Powell, formerly of this city, is now general manager of the Brush-Swan Electric Light Company, and has his office with that of the company, in New York city. Mr. Powell's ability as a systematic organizer and energetic worker is well known to all who remember the remarkable success he achieved in this city some years ago in the insurance business. At the head of a department of agencies, organized through his individual efforts, he built up a large department in connection with the Phœnix Mutual Life Insurance Company which became of great value to him and to the company, and was finally purchased of Mr. Powell by the company for a large sum. The company is fortunate which has the benefit of his perseverance and energy. The Brush electric light was among the first, if not the first to engage public attention for practical electric lighting, and it has held its place well in public favor. It is now claimed for the Brush-Swan system, and the company invite investigation on this point, that under improvements recently adopted by Professor Brush, arc lights of 1,200 to 2,000 candle-power, and incandescent lights of 10 to 20 candles each can be operated from the same machines and wire, avoiding the necessity of two sets of apparatus. They say that investigation will show that with a small amount of power the most perfect illumination may be made at less cost than for gas; and they claim for this system, for plant, maintenance and power, a much less cost than any other. As much as 30 per cent. saving is claimed for the plan that runs both the arc and incandescent lights upon the same machines and wires. It is said for electric lighting generally, that a number of gas companies are assuming into their works the electric light, especially for streets and parks, and that when properly put in and intelligently managed underwriters have favored this system by a lessening of rates against oil and gas The office of the Brush-Swan Company is 204 to 210 Elizabeth street, New York.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING SEPT. 8, 1885.

325,658 Electric switch plug; Jesse H. Bunnell, Brooklyn, N. Y.
325,659 Telephone system; Amos E. Dolbear, Boston, Mass.
325,660 Means for increasing the efficiency of telephones; Amos E. Dolbear, Boston, Mass.
325,702 Printing telegraph; Robert J. Sheehy, New York, N. Y.
325,714 Armature for dynamo-electric machines and electric motors; Sylvanus F. Van Choate, New York, N. Y.
325,748 Means for supporting telegraph wires; Mathias Hettinger, Freeport, Ill.
325,795 Lighting railway cars; Harry E. Freese, Philadelpeia, Pa.
325,802 Arc lamp; George M. Hopkins, Brooklyn N. Y.
325,820 Sewer; James H. Clark, Chicago, Ill.
325,915 Electric locomotive engine; Leo Daft, Greenville, N. J.
325,920 Telephone repeater; Moses G. Farmer, Newport, R. I.
325,952 Telephone switchboard plug; Chester K. Meade, Des Moines, Iowa.
325,958 Incandescent Electric lamp; Otto A. Moses; New York, N. Y.
325,984 Method of laying electric wires; Walton D. Smith, Prophetstown, Ill., assignor of three-fourths to Cyrus Emery, Charles E. Emery, and Cora L. Emery, same place.
326,021 Die for covering wire with insulating material; George M. Cruickshank, Providence, R. I.
326,028 Shallow-water indicator; Ferdinand E. Forster, New York, N. Y.
326,033 Electric battery; Emil G. Hammer, Brooklyn, N. Y.
326,068 Railway signals; Illius A. Timmis and Stanley C. C. Currie, London, County of Middlesex, England.
326,084 Controlling press circuits of printing telegraphs; Clarence L. Healy, Brooklyn, assignor to Stephen D. Field, Yonkers, N. Y.

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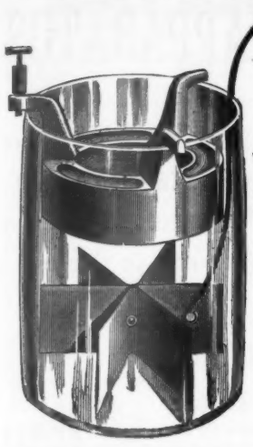

THE MORRISON

Gravity Battery

THE ONLY RELIABLE CLOSED-CIRCUIT BATTERY IN EXISTENCE.

After thirty years' experimenting with other batteries, The Gamewell Fire Alarm Telegraph Co. adopted it as their standard.

OFFICE OF THE GAMEWELL FIRE ALARM TELEGRAPH CO.,
1½ BARCLAY ST., NEW YORK CITY.
NEW YORK, August 14th, 1885.

THE SOUTHERN ELECTRIC CO., BALTIMORE, MD.

Gentlemen:—We have adopted the "MORRISON GRAVITY BATTERY" as the Standard Fire Alarm Battery for this company's service. After thirty years' experience we unhesitatingly endorse it as the best form of Gravity Battery ever devised.

Yours very truly, J. N. GAMEWELL,
General Superintendent Gamewell Police & Fire Alarm Telegraph Co.

Manufactured only by

THE SOUTHERN ELECTRIC CO.,

Warerooms, Hoen Building, cor. North and Lexington Sts.;
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Incandescent Wiring and Repairs to Dynamos and Lamps a specialty.

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THE BEST

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Superior to the Leclanché & all others for Telephone Work, Annunciators, Burglar Alarms, Gas Lighting, etc., etc., in short for all kinds of open circuit work.

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Standard Type-Writer.

Ask for Particulars Regarding the Use of the Remington Type-Writer in Receiving Messages.

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The particular attention of telephone companies is called to the great economy involved in the use of **"DISQUE"** over any other form of **Leclanche Battery;** its present low cost being such that, in quantity, the *Complete* Disque Cell is furnished for the price of a sing'e pair of prisms, while instead of requiring renewal once every four to six months, the Disque Porous Cup does first class transmitter and bell work for from 18 to 30 months.

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BATTERY, COMPLETE,	$1.00	ZINC, WITH CONNECTOR,	$ .10
POROUS CUP, - -	.75	SAL AMMONIAC, - -	.08
GLASS JAR, - - -	.18	COMPLETE CELL, SEALED,	1.20

LARGE DISCOUNTS TO TELEPHONE EXCHANGES AND THE TRADE.

All Disque Leclanche Batteries furnished by us are warranted to be in every particular the same original and genuine article which has during the past ten years become thoroughly well known as the best of all Open Circuit Batteries.

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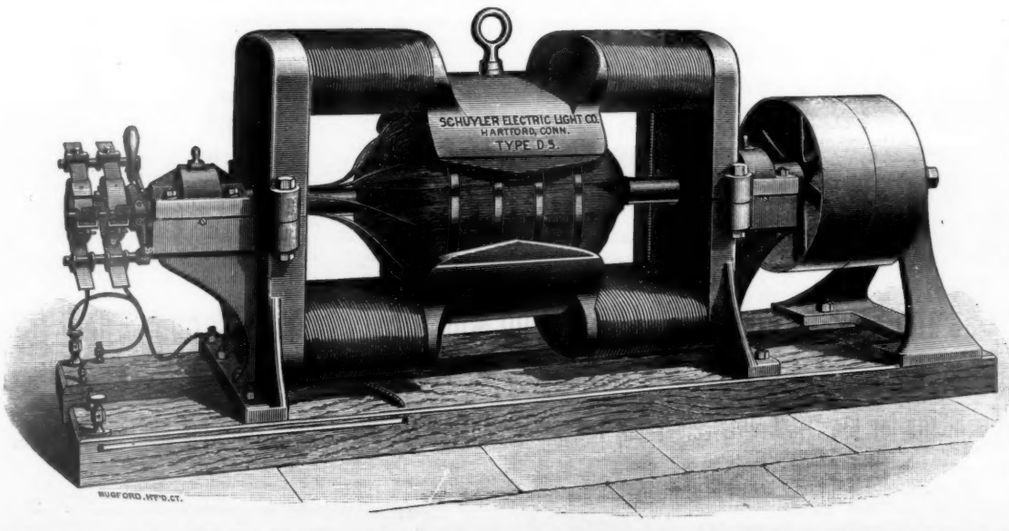
FOR INCANDESCENT AND ARC LIGHTING.



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Dynamo Machines with perfect automatic regulation, reliable and efficient.

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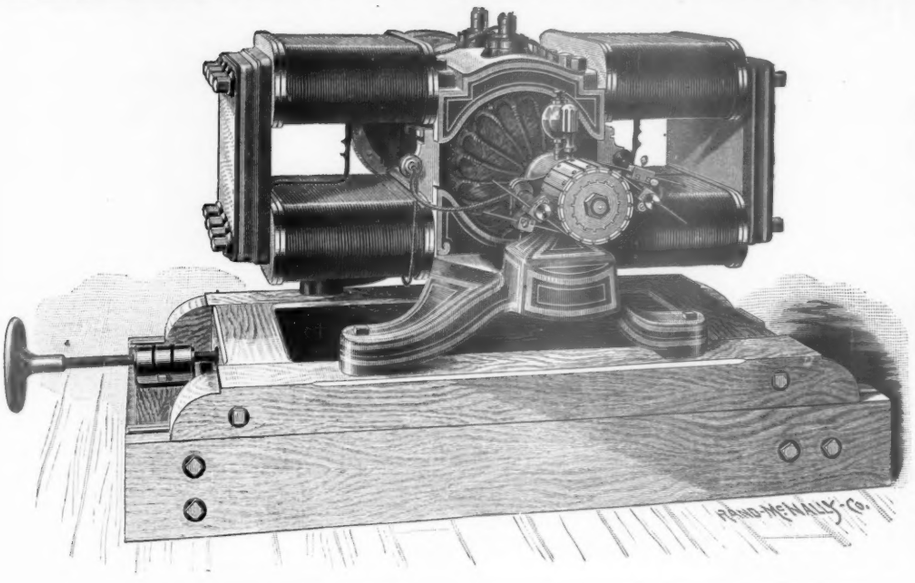

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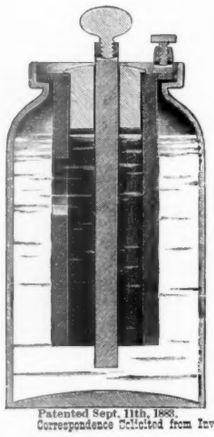

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Cannot be destroyed by short circuit. Carbons practically indestructible, as they can be renewed by simply washing in pure water. Great saving in number of cells required as compared with any Open-Circuit Battery now in use. Can be sealed if desired. *Try it and be convinced.*

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Electric Light and Power Com'y,

Sole Manufacturers of the

THOMAS ELECTRIC LIGHTING APPARATUS.

Fully Protected by Patents.

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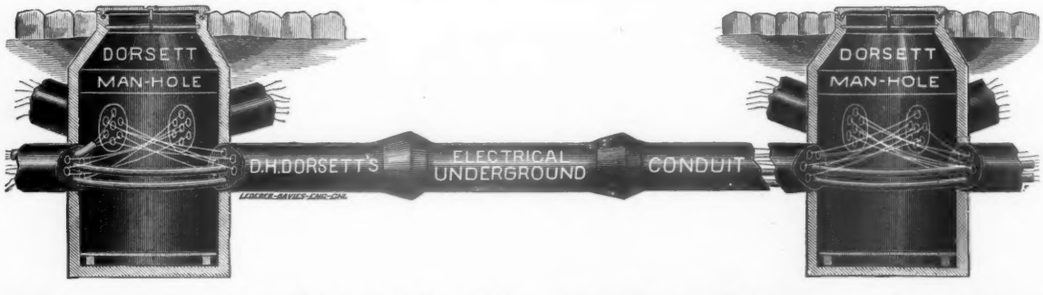

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In all desirable qualities of ELECTRIC ARC LIGHTS the THOMSON-HOUSTON SYSTEM has no equal. The Lights are *superior in color and steadiness*, and the entire apparatus is more *economical*, *efficient* and *safe*, more *easily managed*, and *less liable to derangement* than any other.

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The Thomson-Houston System has been awarded *superiority in all the competitive tests* to which it has been subjected. NEW ILLUSTRATED PAMPHLET will be sent on application.

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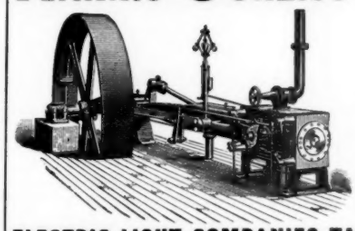

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From 10 to 2000 Horse Power, with Harris's Improvements. These Engines are of
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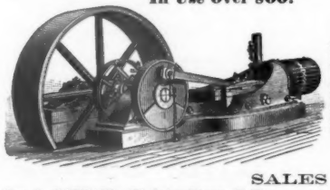
In Use Over 800.
25 to 1,000 H. P.



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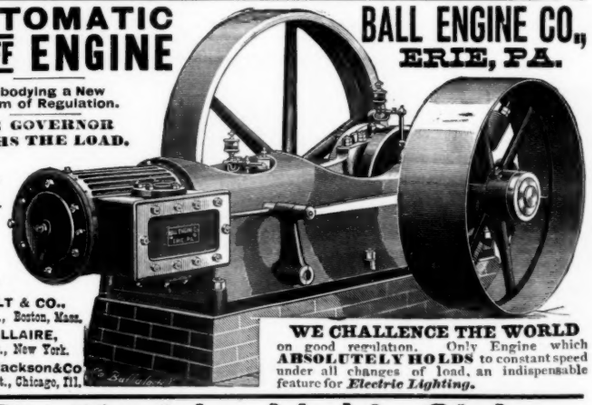

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WE CHALLENGE THE WORLD on good regulation. Only Engine which **ABSOLUTELY HOLDS** to constant speed under all changes of load, an indispensable feature for *Electric Lighting.*

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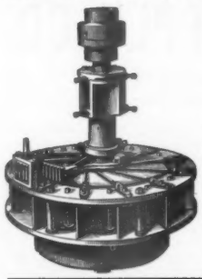

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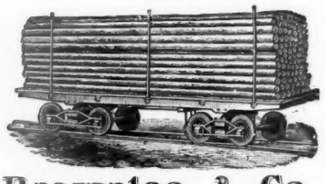

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LECLANCHE ZINCS, with thumb screw or patent spring connections, from pure spelter, and well amalgamated.

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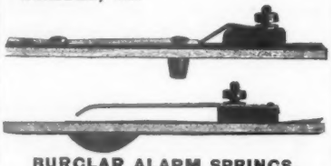

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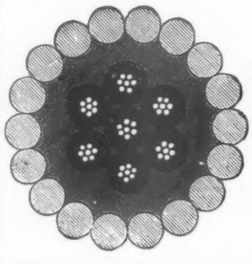

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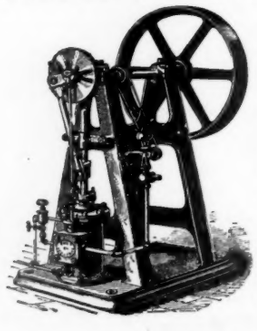

These cuts represent my Patent Single and Double Electric Light Engines, built especially to run Electric Lights.

Of the Single Engines I make 5 sizes, viz.: 4, 6, 8, 10 and 12 horse-power. Of the Double Engines I make 3 sizes, viz.: 15, 20 and 25 horse-power.

These Engines take up very little space, therefore, are very desirable and convenient where room is valuable. With the advantage of many years' practical experience, I have perfected an engine to meet the universal demand for small power. The engines are fitted up with Patent Self-Adjusting Piston Packing, Steel Piston Rods, Gun Metal Boxes and Babbitted Bearings. The working parts are first-class in every respect. Every engine guaranteed to give satisfaction.

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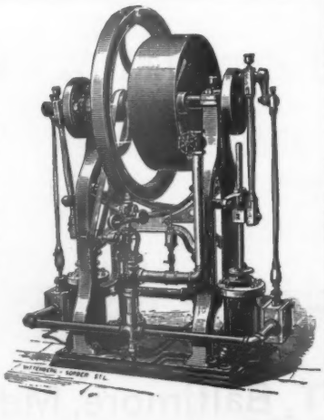

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